SCIENCE ABSTRACTS.

Section A.—PHYSICS.

APRIL, 1927.

GENERAL PHYSICS.

847. *The Density of Fluids. Part I. On a Relation between Density and Temperature and on the Latent Heat of Vaporisation.* **J. H. Shaxby.** (Phil. Mag. 2. pp. 1127–1136, Nov., 1926.)—It is shown that the density ρ of a fluid can be represented by the equation

$$\rho^{\frac{1}{3}} - \alpha \mathrm{T} \log \rho^{\frac{1}{3}} = \rho_1^{\frac{1}{3}} - \alpha \mathrm{T} \log \rho_0^{\frac{1}{3}},$$

where ρ_0 is the maximum density of the substance (*i.e.* density of closest packing when the intermolecular potential energy is zero) and ρ_1 and α are constants. Further $\alpha = \rho_c^{\frac{1}{3}}/\mathrm{T}_c$ when the subscript denotes data at the critical temperature. It is shown that $\rho_1^{\frac{1}{3}} = \frac{4}{3}\rho_c^{\frac{1}{3}}$ and $\rho_0^{\frac{1}{3}} = e^{\frac{1}{3}}\rho_c^{\frac{1}{3}}$. A reduced equation containing no constants peculiar to a particular substance is also obtained. These equations hold very closely for liquids and approximately for saturated vapours. The internal latent heat of vaporisation is discussed, and it is shown that Mills' equation $\mathrm{L}_e = \mathrm{K}(\rho^{\frac{1}{3}} - \sigma^{\frac{1}{3}})$ (ρ = density of liquid, σ = density of vapour) can be deduced from kinetic considerations and does not depend, as he supposed, upon an inverse square law for intermolecular attractions. From the maximum density ρ_0 the diameters of molecules can be estimated.

A. A. D.

848. *The Absolute Density and Coefficient of Expansion of Silicon Tetrachloride.* **P. L. Robinson** and **H. C. Smith.** (Chem. Soc., J. pp. 3152–3153, Dec., 1926.)—An addendum to a previous paper [see Abstract 2255 (1926)]. The values obtained were relative, as the difference in density of the glass floats employed at the temperature of standardisation and of use were not considered. This has now been done, and tables giving the final values for specimens of silicon tetrachloride prepared from material obtained from five widely separated sources are contained in the present paper. The relative atomic weights remain the same, so that there is still no evidence of variation in the isotropic constitution of terrestrial silicon.

H. N. A.

849. *Densities of Particles in Smokes.* **H. S. Patterson** and **R. Whytlaw-Gray.** (Roy. Soc., Proc. 113. pp. 302–311, Dec. 1, 1926.)—A cell was constructed to permit observation of the fall of smoke particles under gravity and their ascent caused by an electric field, the measurements being extended by variation of the charge on the particles. The density of the aggregates can thus be obtained. Smokes were obtained from CdO, Au, Ag, Hg, $HgCl_2$ and MgO, and the method tested by oil droplets. It was found that the Cunningham equation was applicable to determine the radii of the particles. It is concluded that smoke particles are much larger than was usually supposed, being in many cases of microscopic and not ultra-microscopic dimensions, and this was confirmed by visual observations under green light with a microscope and by photography of the deposited particles. The results confirm those obtained by Bär, and by Kohlschütter and Tüscher [see Abstract 405 (1922)]. R. S. R.

850. *Gaultier Graphical Tacheometer.* (Rev. d'Optique, 5. pp. 425–435, Oct., 1926.)—Particulars are given of the construction and method of use of the instrument, which registers on paper the outline of the plan required. It can be used for map construction, levelling or the measurements of azimuth, and the resulting errors are not greater than 0·1%. R. S. R.

851. *Most Favourable Value for the Time Constant of an Electrically Maintained Oscillatory Movement.* **A. Guillet.** (Comptes Rendus, 183. pp. 870–873, Nov. 15, 1926.)—Equations, based on theoretical considerations, are given relating the effects of time and intensity of impulse to the period, amplitude and energy of a vibrating diapason or pendulum actuated by electromagnets. Although the formulæ explain the wide latitude possible for the time constant and the consequent tolerance of the application of this means of control, it is pointed out, for example, that in the case of a diapason of frequency 100 under optimum conditions, the time constant has a value ten times that necessary to give the same advantages with a frequency of 1000. A. B. C. L.

852. *A New Hygrometer.* **A. Romberg** and **L. W. Blau.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 717–724, Dec., 1926.)—The hygrometer described is continuous-indicating; a value of the humidity is obtained by balancing a column of atmospheric air against a column of air saturated with water vapour and observing the effect, on a suspended vane, of the difference of pressure due to the different densities. The instrument used in the investigation is more sensitive than the Regnault-Alluard type of dew-point hygrometer, and can be made a hundred times as sensitive if required. AUTHORS.

853. *A Hygrometer Employing Glycerine.* **E. Griffiths** and **J. H. Awbery.** (Phys. Soc., Proc. 39. pp. 79–84; Disc., 84. Dec., 1926.)—Glycerine is selected as the hygrometric substance because it is common, easily reproduced, and past history does not affect its properties. In the experiments described the glycerine is applied directly to one face of a prism forming part of an Abbé refractometer. This is placed in an enclosure where the humidity is controlled and measured and an accurate relation between the humidity of the air and the refractive index of the glycerine found. The effect of temperature change on the glycerine is measured, and the time lag also. The time lag curve is approximately exponential, the total lag being about fifteen minutes. For the instrument it is claimed that after an initial setting the refractive index scale can be engraved directly in humidities, and it is portable and reasonable robust. In the *Discussion*, **C. V. Boys** described another type of glycerine hygrometer. R. S. R.

854. *Humidity Measurements.* **H. Ebert.** (Phys. Zeits. 27. pp. 869-870, Dec. 15, 1926. Paper read before the Deut. Naturforscher. u. Ärzte, Düsseldorf.)—Consideration is given first to the values of relative humidity obtained by Sprung's theory and the conditions under which the humidity tables are applicable. To extend the range of direct measurement values are found with an aspiration psychrometer and by an absorption method of the humidity of various samples of damp air at a temperature of 60° C. Relative humidities from 20 % to 90 % were employed. At 20 % and 60° C. a difference of 5–6 %, with an accuracy of ± 1%, was found between the humidity values for the two methods. R. S. R.

855. *Theory of the Vane Anemometer.* **E. Ower.** (Phil. Mag. 2. pp. 881–900, Nov., 1926.)—The writer urges that the vane anemometer, when used to measure speeds for which it has been designed and calibrated, can give very accurate results, and is thoroughly reliable. The calibration curve is sensibly straight, except for small speeds where the friction of the instrument has a marked effect. After obtaining the general equations of motion, the author examines the effects of variations of wind speed and air density. The effect of fluctuations ordinarily met with is less than 1 %; the effect of air density is much more at low than at high speeds, and should be taken into account in accurate work; the effect of a wind speed varying across the vane circle is shown to be small. W. G. B.

856. *Springs for Vertical Seismographs.* **L. F. Richardson.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 403–411, Dec., 1926.)—A difficulty arises with vertical pendulums on account of the period of oscillation changing with the position of the centre of oscillation. The requirements of springs for second order aberration are determined and the means of eliminating this. With a single spring removal of second order aberration leads to great first order aberration, but by a combination of two springs, one controlling the period without exerting any couple in the standard position, the other acting at right angles to the line joining one of its ends to the axis of rotation, both aberrations may be removed. The removal of third order aberration is investigated and models made to test the results deduced from theory. It is hoped to cure the third order defects by better design and workmanship of the hinges. R. S. R.

857. *A Rapid Bolometer made by Sputtering on Thin Films.* **H. Dewhurst.** (Phys. Soc., Proc. 39. pp. 39–77; Disc., 77–78, Dec., 1926.)—Thin Films.—The method of making thin films of collodion by drying weak solutions in ether and alcohol on the surface of clean mercury, and their subsequent removal, is described. Flexible films are also made in the same way, using a modified formula, producing very robust films which withstand great distortion, and will stand being punctured without fracture. Both types can be produced rapidly and cheaply down to a thickness of one wave-length of light.

Sputtering.—Two novel types of sputtering apparatus are described, together with working data. A table is given containing sputtering data for twenty-five metals, nine of which appear for the first time. Notes relating to the effects of shape and age of kathode, shape of anode, form of dark-space and kathode temperature appear, together with novel modifications in the design of the Wehnelt break. Approximate temperature coefficients of resistance are assigned to eight new metals and more accurate values to three others, that relating to gold being new. The apparatus used for these determinations is described. Notes and curves on ageing appear regarding six metals and resistances for films of standard size for ten metals. A curve is given throwing, perhaps, some light on the formation of a sputtered film.

Bolometer.—Apparatus are described by which rings are moulded for supporting the thin collodion films and providing a reliable contact for overlying sputtered metallic films. The method of making the bolometers, together with holders of various types, and apparatus for blackening, are detailed. The comparative sensitivity of these new bolometers is discussed, and curves and an empirical formula given from which an estimation of the speed of the instruments can be determined. The new type is roughly 400 % faster than a representative bolometer of the Lummer and Kurlbaum type. The thickness of the component metal film is estimated. AUTHOR.

858. *The Measurement of Fine Wires.* **G. A. Tomlinson.** (Journ. Sci. Instruments, 4. pp. 74–75, Dec., 1926.)—A mechanical method of measuring fine wires is described. The measurement is made at a point and with a very light pressure so that no deformation occurs. The accuracy of the measurement is 0·00001 in. AUTHOR.

859. *Ring Method for the Determination of Surface Tension.* **W. D. Harkins, T. F. Young** and **L. H. Cheng.** (Science, 64. pp. 333–336, Oct. 1, 1926.)—It is pointed out that the theory of the ring method developed by MacDougall and others [see Abstract 15 (1926)] holds well only for rings of dimensions not usually employed in practice, errors of the order of as much as 12 % resulting. With a view to obtaining a much greater accuracy a correction factor, the value of which can be experimentally determined, is introduced into the formula used for calculating the results. A. B. C. L.

860. *Surface Tension of Insulating Liquids in an Electric Field.* **G. Bruhat** and **M. Pauthenier.** (Comptes Rendus, 183. pp. 1272–1274, Dec. 29, 1926.)—It is demonstrated by a theoretical treatment based upon thermodynamic principles that the surface tension of a liquid dielectric is independent of superimposed electric fields, thus confirming recent experimental conclusions. [See Abstract 1883 (1926).] A. B. C. L.

861. *A Further Note upon "Intertraction."* **N. K. Adam.** (Roy. Soc., Proc. 113. pp. 478–479, Dec. 1, 1926.)—Refers to a paper by A. Wright describing a new phenomenon, which he explains as due to "intertraction" [see Abstract 13 (1927)]. The author has repeated the experiment and made some further observations which afford an explanation on the lines of his former treatment of the "intertraction" phenomena, ascribing the coloured streamers to a circulation due to a difference of diffusivity between the solutes in the horizontal paper disc and in the bulk liquid, on which it floats horizontally, and not to the "intertraction" effect predicted by Clerk Maxwell. If this could be proved to exist it would show that in the surface of a liquid there was a kind of "contractile skin" which would become an expanding skin on reversal of the sign of the surface tension. H. N. A.

862. *Simple Kinetic Theory of Viscosity.* **J. S. Dunn.** (Faraday Soc., Trans. 22. pp. 401–405, Nov., 1926.)—An exponential relationship connecting fluidity with temperature is developed from considerations of kinetic theory. Good linear agreement with observed data for a large number of substances is found on plotting logarithms of fluidity against reciprocals of absolute temperatures. In the equation $1/n = Ae^{-Q/RT}$ Q is identified with a quantity of energy which it is necessary to impart to any molecule in order to overcome the attraction of all its neighbours, and it is argued that the values of Q would vary in a regular manner in a homologous series. This expectation is completely realised, except in the case of the first two members of a series. The successive values of Q are found to form a geometrical progression of common ratio approximately 1·12 for all homologous series investigated. A similar relationship between fluidity and vapour pressure is discussed. A. B. C. L.

863. *Viscosity of Copper and its Alloys.* **J. Cournot** and **R. Pages.** (Comptes Rendus, 183. pp. 885–886, Nov. 15, 1926.)—Gives results for copper, brasses, and cupro-aluminium similar to those for steels published in a former paper. [See Abstract 433 (1926).] W. G. B.

864. *Capillarity and Wetting of Surfaces.* **K. Schultze.** (Kolloid Zeits. 40. pp. 12–16, Sept., 1926.)—Unless a solid surface is truly plane spreading of a liquid is conditioned by the rise and passage of liquids through capillary pores. Experiments are made with specimens of glass, agar, and gelatine in which capillaries have been inserted. It is found that the filling of these capillaries by a liquid placed in contact depends on the surface tension of the liquid, the cross-section of the capillaries, their direction, and whether continuous or with closed ends. If vertical, the liquid by its capillary rise can displace all the air if the conditions permit of bubble formation. If the capillaries are horizontal or tortuous, air may become imprisoned or its displacement not made possible. The flotation of powders is related to this same effect of the difficulty of filling with liquid the capillaries with which the grains are traversed. J. N. P.

865. *Geometry of Dynamics.* **J. L. Synge.** (Roy. Soc., Phil. Trans. 226. pp. 31–106, Aug. 17, 1926.)—By the aid of the tensor calculus a general dynamical theory, as applied to the Newtonian dynamics of a system of particles or of rigid bodies, is developed. The reasoning is essentially analytical, but the results are translated as far as possible into geometrical language. In Chapter I the various types of dynamical manifold are outlined. Chapter II is concerned with certain geometrical properties of Riemannian space. Chapters III and IV contain discussions of the manifold of configurations with the two important types of line-element. In Chapter V there are given necessary and sufficient conditions that all the coordinates but one should be ignorable. The rest of the paper deals with the question of the stability of the states of motion. The discussion is based on the Lagrangian equations, which are well adapted for the tensorial method. In Chapter VI there is given a geometrical definition of stability which yields three types of dynamical stability. Chapters VII–IX contain analytical treatments of the problem of the stability of a state of motion (not necessarily steady). The motion of the curvature tensor is introduced. A. B. C. L.

866. *Relative Kinetic Energy.* **B. Finzi.** (Accad. Lincei, Atti, 4. pp. 506–508, Dec. 5, 1926.)—Considering a material system, let T be its absolute kinetic energy, T_1 the kinetic energy relative to an observer provided with a moving trihedral, and T_2 the kinetic energy of displacement. T can be expressed in terms of T_1 and T_2. Taking the particular case in which the material system is continuous and the absolute motion stationary, it follows that, in the absence of external forces and for appropriate values of the constants, the absolute kinetic energy is equal to the relative kinetic energy less the kinetic energy of displacement. Omitting the condition that the absolute motion is stationary, and taking, by way of application, a solid moving uniformly in an infinite fluid and the effect on the solid of the mobile observer, in order that the classical principle of relativity may hold good for the displacement in respect of the duration of the kinetic energy, d'Alembert's paradox must necessarily exist. Entirely mathematical. E. F.

867. *The Equations of Motion of a Non-Holonomous System.* **G. Vranceanu.** (Accad. Lincei, Atti, 4. pp. 508–511, Dec. 5, 1926.)—Entirely mathematical. E. F.

868. *Inversion of Poisson's Formula on Rigid Motions.* **U. Cisotti.** (Accad. Lincei, Atti, 4. pp. 237–241, Oct., 1926.)—Poisson's equations $d\mathbf{i}/dt = [\boldsymbol{\omega} \,.\, \mathbf{i}]$, $d\mathbf{j}/dt = [\boldsymbol{\omega} \,.\, \mathbf{j}]$, $d\mathbf{k}/dt = [\boldsymbol{\omega} \,.\, \mathbf{k}]$ are shown to correspond to the inverse form

$$\mathbf{i} = \frac{1}{\omega^2}\left[\frac{d\mathbf{i}}{dt} \cdot \boldsymbol{\omega}\right] + \alpha\boldsymbol{\omega},$$

$$\mathbf{j} = \frac{1}{\omega^2}\left[\frac{d\mathbf{j}}{dt} \cdot \boldsymbol{\omega}\right] + \beta\boldsymbol{\omega},$$

$$\mathbf{k} = \frac{1}{\omega^2}\left[\frac{d\mathbf{k}}{dt} \cdot \boldsymbol{\omega}\right] + \gamma\boldsymbol{\omega}.$$

The paper is entirely mathematical. A. Wh.

869. *General Formulæ for the Calculation of the Dynamic Effect of a Fluid Stream between a Strip and a Plane Obstacle.* **E. Raimondi.** (Accad. Lincei, Atti, 4. pp. 272–275, Oct., 1926.)—Entirely mathematical. A. Wh.

870. *Motion of a Sphere in a Rotating Liquid.* **S. F. Grace.** (Roy. Soc., Proc. 113. pp. 46–77, Nov. 1, 1926.)—The general small motion of a sphere in a rotating liquid is shown to depend on two special types of motion, a uniform translation parallel to the axis, and a uniform translation (relative to axes moving with the liquid) at right angles to the axis. In the first, the resultant pressure is opposite to the direction of motion, and in the second is at right angles to the motion, and inclined at about 141° to the line of motion. In both cases the fluid motion is small except near the equatorial plane in the neighbourhood of the sphere. Mainly mathematical. W. G. B.

871. *Irrotational Flow past Two Intersecting Planes.* **W. B. Morton.** (Phil. Mag. 2. pp. 900–912, Nov., 1926.)—By means of the solution of the problem of the electrification of two intersecting planes [see Abstract 1416 (1926)] the solution for hydrodynamic flow is obtained. Typical stream-lines are plotted, and the torque due to the fluid pressures is calculated. W. G. B.

872. *Flow by Jet.* **R. Mazet.** (Comptes Rendus, 183. pp. 735–736, Nov. 3, and pp. 863–865, Nov. 15, 1926.)—Commencement of a Liquid Jet.—Obtains some integral theorems for the velocity potential in plane irrotational flow through an orifice in a jet. Mathematical. W. G. B.

873. *Cinematographic Examination of Plane Fluid Motion past Obstacles.* **A. Toussaint** and **E. Carafoli.** (Comptes Rendus, 183. pp. 947–948, Nov. 22, 1926.)—At small speeds vortices are formed near the point of division of the central stream-line, and these move along the boundary. At greater speeds these disappear, but "dead water" begins to appear, and its boundaries become turbulent at some distance. At higher speeds alternate vortices are thrown off behind, and these enhance the effect of the wake. A stepped profile is found to diminish the effects of the stream disengaging from the boundary, which may explain the reason why stepped wing profiles give greater lift than smooth ones. W. G. B.

874. *Flow of Liquids in Pipes or Channels.* **H. W. March** and **C. N. Ward.** (Frank. Inst., J. 202. pp. 811–815, Dec., 1926.)—The authors criticise a theory of fluid flow put forward by A. B. Cox [see Abstract 766 (1925)] on both theoretical and experimental grounds. The author of the original article replies, calling attention to what he considers a fallacy in the proof of the formula for the velocity in the case of stream-line flow, as given in Lamb's "Hydrodynamics." F. S. B.

875. *Angular Slip of Pulleys and that of Driving and Driven Belts.* **Swyngedauw.** (Comptes Rendus, 183. pp. 1329–1331, Dec. 27, 1926.)—A series of experiments are described in this paper which demonstrate clearly that pulley slip is always greater than belt slip. The pulley measurements were made by an electrical method already published [see Abstract 541 (1927)] and the belt data were obtained by a stroboscopic method also previously described [see Abstracts 1216 and 1995 (1926)]. It is found that for the same couple transmitted at a given speed, the difference $\nu - g$ of the two slips diminishes as the tension increases and tends towards zero for a tension greater than that in use; also for the same couple transmitted at the same speed and static tension, the slip and the difference $\nu - g$ are greater when the leather belt works fore than aft upon the pulley. The functional slip ϕ_m upon the driving pulley in general exceeds the ϕ_g of the driven pulley by a quantity $\phi_m - \phi_g$ of the same order as $\nu - g$. The three slips satisfy the inequality $\nu > g > (\phi_m + \phi_g)/2$. H. H. Ho.

876. *A Very General Construction of Certain Profiles used in Aviation by Conformal Transformation of a Circle.* **M. Girault.** (Comptes Rendus, 183. pp. 1331–1333, Dec. 27, 1926.)—The profiles in question are those due to Joukowski and Witoszinski (Rev. Gen. de l'Aéronautique, 4. p. 40, 1924), and are obtained by simple transformations for which the paper should be consulted. H. H. Ho.

877. *Statical Hysteresis in the Flexure of Bars.* **G. H. Keulegan.** (Bureau of Standards, Technol. Papers, No. 332. pp. 145–162, Washington, 1926.)—Boltzmann's theory of elastic time effects ("elastische Nachwirkung") does not always account for the hysteresis observed in the deformation of an elastic body during a closed load cycle. In fact, there are materials for which the component of hysteresis which is due to the time effects constitutes only a small portion of the observed hysteresis. Thus other supplementary theories are required to account for that portion of the hysteresis which Boltzmann's theory does not explain. In this paper is presented an additional theory of hysteresis on the assumption that the stress-strain relation of elastic bodies in a cyclic state for a stress cycle σ_1 to $\sigma_1 + \sigma_m$ and back to σ_1, instead of being given by a straight line, is given by a symmetrical loop when the time effects are negligible. Hysteresis arising from this source is called statical hysteresis. The theory is developed to show how the statical hysteresis of a rectangular bar, one end of which is clamped and the other end loaded, depends on the length of the bar and on the load. AUTHOR.

878. *Plasticity, Tenacity and Recrystallisation.* **R. Becker.** (Zeits. techn. Physik, 7. 11. pp. 547–555, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—The technical properties of metals are explainable qualitatively if the lattice theory of crystal physics is amplified by consideration of the variations in the thermal stresses, of lattice disturbances and of changes in the positions of the atoms. The close dependence of the plasticity of crystals on the temperature and its complete disappearance at sufficiently low temperatures compel the view that the cause of the plasticity is to be sought in thermal motion, especially in thermal variations. The structure of the moulded material is to be regarded as an intermediate stage between the crystal and the perfectly amorphous supercooled liquid. This view furnishes an acceptable explanation of the recrystallisation diagram, and of the various related phenomena. T. H. P.

879. *The Formation of Twinned Metallic Crystals.* **H. C. H. Carpenter** and **S. Tamura.** (Roy. Soc., Proc. 113. pp. 161–182, Nov. 1, 1926.)—Experiments on "annealing twins" have been made principally with copper and certain of its alloys. These are produced by straining followed by heat treatment, during which recrystallisation and crystal growth occur. These twins are structurally very stable. Specific instances of twinning in other metals and alloys have also been investigated. It is suggested that the principal cause of twinning is crystal growth. Deformation is an indirect cause of twinning, merely because it causes subsequent growth on annealing. In some cases the orientation of annealing twins indicates that they have grown along certain crystallographic directions. Most frequently they are rectilinear, but sometimes they are markedly curved. The capacity for forming annealing twins appears to be closely related to the atomic arrangement in the crystal lattice of the metal. Those metals which crystallise in the face-centred cubic, tetrahedral cubic, and face-centred tetragonal lattices produce annealing twins after suitable treatment, whereas metals possessing other atomic arrangements have not been found to produce them. Fine strain-etch lines may be developed in any metal after appropriate treatment, but they vanish entirely on heating. Metals which crystallise in the close-packed hexagonal lattice—*e.g.*, zinc and cadmium—have no possible planes of twinning, and what is called twinning in these metals is probably parallel growth. AUTHORS.

880. *The Space-Groups of the Rhombic and Monoclinic Heptahydrates of the Sulphates of the Bivalent Metals.* **H. G. K. Westenbrink.** (K. Akad. Amsterdam, Proc. 29. 9. pp. 1223–1232, 1926.)—The rhombic salts investigated were $MgSO_4 - 7H_2O$, $MgCrO_4 - 7H_2O$, $ZnSO_4 - 7H_2O$ and $NiSO_4 - 7H_2O$. The unit cell contains in each case four molecules, and the grating is built up of simple rhombic cells; this disagrees with Jackson's hypothesis, based on a study of the paramagnetism of these sulphates at low temperatures, that the grating consists of body-centred cells. There are four rhombic-bisphenoidal space groups, V_1, V_2, V_3, and V_4 in Wyckoff's notation; the reflections observed show that in the present case we are dealing with V_4. A table gives the axial ratios $a : b : c$, the values of a_0, b_0, and c_0 determined by the X-ray method and the observed and calculated specific weights of the four salts. The monocline-prismatic forms of $FeSO_4 - 7H_2O$ and $C_0SO_4 - 7H_2O$ were also studied; the unit cell contains sixteen molecules and the space group is C^6_{2h}. The relation between the arrangement of the molecules and that in the rhombic sulphates is discussed; it seems possible that one structure can be transformed into the other by relatively small translations and rotations as is shown by means of a diagram. The so-called molecular volumes of all these crystals differ little from one another, the largest value being 245·9 Å.U.^{3} for Mg-chromate (rhombic) and the smallest 241·4 for Fe-sulphate (monoclinic). H. N. A.

881. *Shear Strengthening of Monocrystals in Plastic Deformation.* **E. Schmid.** (Zeits. f. Physik, 40. 1–2. pp. 54–74, 1926.)—The shear strengthening of Zn crystals in the basal slip surface has been examined; after the elastic limit has been passed the resistance to shear in this direction increases linearly with the slip. Shear strengthening of a latent slip system has been shown to exist in the case of the prism of the first kind in mixture crystals of Zn and Cd. The shearing strengths of the two slip systems observed in Zn crystals, basal and prism of the first kind (in each case with a diagonal axis of the first kind as slip direction) have in the unstretched crystal the ratio of about 1 : 7·0. Strengthening takes place more rapidly in the basal slip surface than in the latent prism face of the first kind, in which the atoms are not as close together as in the former; this is more marked when the stretching takes place rapidly. The "after stretching" due to prism slip takes place in such a manner as to show that the active slip system is considerably less strengthened than another latent one, which is equivalent to it crystallographically. The same is true of tin crystals. H. N. A.

882. *Crystal Classification.* **J. Beckenkamp.** (Zeits. f. Physik, 40. 3–4. pp. 237–254, 1926.)—A theoretical paper dealing with the crystal as a homogeneous polyhedron and with the relation of physical properties of the crystal and the particular space-group of geometrical crystallography.

W. H. Ge.

883. *Rotation Method of X-Ray Crystallography.* **J. D. Bernal.** (Roy. Soc., Proc. 113. pp. 117–160, Nov. 1, 1926.)—An important paper giving the first account in English of general methods of interpretation of X-ray, single crystal, rotation photographs. The Ewald reciprocal lattice and the geometrical law of this lattice corresponding to the Bragg law of X-ray diffraction in crystals are discussed; the interaction of the reciprocal lattice with homogeneous X-rays is analysed; the determination of the size of the true unit cell, and the determination of the indices of the crystal plane from the position of the reflected ray upon the photographic plate or film are explained; and the requirements of a spectrometer, with which reliable results can be obtained, are stated. A special feature of the paper is the number of transparent charts which very considerably reduce the numerical calculations normally required. Their use is as follows: Chart I.—Reciprocal lattice coordinates (ξ, ζ) corresponding to any spot on a quarter-plate photograph taken at about 4 cm. from the rotating crystal. Chart II.—(ξ, ζ) coordinates when a circular camera is used. Chart III.—The glancing angle (θ) and the angle between the normal to the reflecting plane and the axis of rotation. Chart IV.—Especially useful for the interpretation of oscillation photographs when it is required to know at what angle a particular plane will reflect. The remaining and larger portion of the paper deals with the special difficulties which arise in the X-ray analysis of crystals belonging to the different crystal systems. Among subjects discussed are the determination of the correct unit cells of monoclinic and triclinic crystals, the choice of axes of complete rotation which shall reduce to a minimum the number of unresolvable spots and a detailed discussion of the *oscillation* method which still further reduces the number of unresolvable spots. A table is provided to facilitate calculations where results more accurate than those given by the graphical methods are required.

W. H. Ge.

884. *Influence of Impurities on the Temperature of Paramorphic Transformation of Cristabolite.* **R. Weil.** (Comptes Rendus, 183. pp. 753–755, Nov. 3, 1926.)—Describes additional experiments confirming the conclusions arrived at in a previous paper [see Abstract 2001 (1926)], in which the author concluded that the differences observed in the temperature of transformation were caused by impurities. It is shown that this temperature is raised some 40° C. by treatment with concentrated sulphuric acid in the case of some cristabolites in which it is originally low, and it is suggested that this is due to the dissolving out of an impurity. Artificial cristabolites prepared by heating quartz have a transformation temperature from 230° to 260° C., while that of cristabolite prepared from quartz glass, to which alkalies are added by the manufacturers to increase the fluidity of the melted material, is from 175° to 210° C. The transformation temperature of 220° to 260° C. of certain cristabolites can be lowered by about 20° C. by heating them in a flame containing various alkalies. The smaller variations of the temperature of transformation between 220° and 260° seem to be due to non-volatile impurities Fe, Ca, Mg. H. N. A.

885. *The Crystalline Structure of Anhydrite.* **J. A. Wasastjerna.** (Phil. Mag. 2. pp. 992–994, Nov., 1926.)—Refers to a paper on the subject by Dickson and Binks [see Abstract 2251 (1926)]. The author had previously arrived at two alternative structures A and B of the same type and very closely related to one another; a displacement of the atom groups in the direction of the a axis of 0·05 transforms one into the other. The author preferred alternative B, while the parameter values of Dickson and Binks correspond to alternative A. Alternative A for the reflection (210) leads to a theoretical intensity which does not agree with experiment, this was also noticed by Dickson and Binks, but they held to structure A, since B does not agree well with the measured reflections (202), (220) and (440). H. N. A.

886. *Crystal Structures of the Selenides of Glucinum, Zinc, Cadmium and Mercury.* **W. Zachariasen.** (Zeits. phys. Chem. 124. pp. 436–448, Dec. 30, 1926.)—Investigation of the crystal structure by the powder method shows that the compounds, BeSe, ZnSe, and HgSe crystallise in the regular system with zinc blende structure; the lengths of the side of the elementary cube a_w are respectively 5·129 ± 0·004, 5·661 ± 0·003, and 6·068 ± 0·004 Å., and the calculated densities, 4·315, 5·261, and 8·266. The cadmium compound, CdSe, crystallises in the hexagonal system and in the c_6v^4 space group and possesses wurtzite structure; the lattice dimensions are $a = 4 \cdot 30 \pm 0 \cdot 01$ Å., $c = 7 \cdot 01 \pm 0 \cdot 02$ Å., $c : a = 1 \cdot 630$, and the calculated density 5·63. A method is outlined for determining the probable limits of error for estimations of lattice constants. T. H. P.

887. *On Crystallised Nitrogen.* **D. Vorländer** and **W. H. Keesom.** (K. Akad. Amsterdam, Proc. 29. 8. pp. 1069–1074, 1926.)—Wahl found that nitrogen crystallises at 210° in the cubic system and is optically completely isotropic; de Smedt and Keesom examined the crystals by means of X-rays at − 253°, and found that in all probability they are not cubic; Eucken as well as Keesom and K. Onnes had already established the fact that a transformation takes place at 35·5° K. The above would indicate that solid nitrogen behaves like white phosphorus. The authors have investigated solid nitrogen at a number of temperatures microscopically between crossed nicols, introducing a gypsum plate for some of the observations; they found no evidence of any change of crystalline form with temperature, and nitrogen proved to be very slightly doubly refracting at the melting-point. Observations were also made on crystallised argon. H. N. A.

888. *Crystalline Forms of 5-Nitro-Salicylic Acid and of Related Compounds.* **F. D. Chattaway** and **W. R. C. Curjel.** (Chem. Soc., J. pp. 3210–3215, Dec., 1926.)—5-nitro-salicylic acid monohydrate is obtained in unstable hair-like colourless needles by crystallisation from aqueous solutions. The transition temperature, determined by the intersection of the solubility curves of the hydrate and acid in water is 42·5°. Anhydrous 5-nitro-salicylic acid deposited from acetic acid or from acetone-ethyl acetate solutions, exists in compact crystals belonging to the holohedral class of the anorthic system, with axial elements $a:b:c = 1\cdot7456:1:1\cdot0945$; $\alpha = 96°16'$, $\beta = 114°6'$, $\gamma = 88°40'$; $d_{18\cdot5°}$ is 1·654. The crystals have a cleavage plane and the resultant fragments show a biaxial interference figure. The double refraction is strong and negative. Ethyl-5-nitrosalicylate *mp*96°, $d_{19°}$1·429, is obtained from carbon tetrachloride solution in crystals belonging to the monoclinic system and of prismatic habit. Axial elements are $a:b:c = 0\cdot9530:1:0\cdot4377$, $\beta = 122°38'$. 5-nitro-2-ethoxybenzaldehydesemicarbazone crystallises from rapidly cooled solutions, in an almost colourless, labile modification which changes in contact with the mother liquid, to stable yellow crystals belonging to the monoclinic system and having axial elements $a:b:c = 1\cdot3963 . 1 : 2\cdot1269$, $\beta = 104°26$; $d_{18\cdot5°} = 1\cdot437$. L. M. C.

889. *Space Lattice of Permalloy.* **R. Forster.** (Phys. Zeits. 27. pp. 829–830, Dec. 15, 1926.)—This alloy (78 % Ni + 22 % Fe) has a face-centred cubic lattice like nickel, but with the cube edge increased to 3·56 Å., and is thus similar to the corresponding 70 : 30 alloy. The high initial magnetic permeability of the permalloy is thus without influence on the Röntgen diagram. Just as with the copper-gold alloys, so also with the nickel-iron alloys, the lattice constant is additive.

T. H. P.

890. *The Orientation of the Crystallites in Metals in Relation to the Elastic Properties.* **G. Tammann.** (Zeits. techn. Physik, 7. 11. pp. 531–534, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—Describes a method by which the degree of orientation of the crystallites obtained during mechanical treatment, such as rolling, can be ascertained with fair rapidity. When a polished surface of the metal is etched with a suitable fluid the surfaces of the individual crystallites are attacked, forming either minute hillocks or pits, which are similar and similarly situated over the surface of an individual crystallite. Light is thus reflected by each individual in certain definite directions, so that when the plate is turned through 360° each individual crystallite flashes out a certain number of times, four times for a cube surface in a cubic crystal, three times for an octahedron surface, and twice for a dodecahedron surface. Even when the sections do not exactly coincide with one of the above crystal surfaces the etching occurs with one of the above numbers of flashes, and by counting these numbers it becomes possible to distinguish, for all the visible crystallites, between the different degrees of working of the specimens which alter the orientation of the crystallites, and so change the number of surfaces of each kind in a particular plane.

H. N. A.

891. *Werner's Coordination Theory and the Electrical Structure of the Atom.* **S. H. C. Briggs.** (Phil. Mag. 2. pp. 1026–1041, Nov., 1926.)—Introduces a theory of duplex affinity. Positive affinity means a tendency to lose electrons, negative affinity a tendency to gain them. In KCl the original K atom has + affinity and the Cl atom negative; the K-ion, however, according to this definition has negative affinity, since it has a tendency to gain an electron under suitable conditions, while the Cl-ion has positive affinity. The affinity of the atom is described as primary, and that of the ion as secondary. There is an important difference between secondary negative and secondary positive affinity ; in a positive ion the charge is situated in the nucleus and the attractive force, or secondary negative affinity, may be regarded as distributed evenly over the outside surface of the atomic sphere. This is not the case with the negative ion. Werner's conception of chemical affinity as an attractive force directed from the centre of the atom equally to all points on the surface of the atomic sphere applies to all cases with secondary negative affinity, but not to cases with secondary positive affinity, in which the electrons are equally shared as in CCl_4 ; in some cases, however, the secondary positive affinity is divided up equally between all the external electrons, as in Cl^-, and the general effect is equivalent to an attractive force acting from the centre. It is significant that the majority of complexes have a positive atom at the centre. Werner's coordination process is examined in the case of complex salts, and traced in the solution and crystallisation of strong electrolytes and in the phenomena of electrolytic " solution pressure."

H. N. A.

892. *Atomic Radii.* **M. L. Huggins.** (Phys. Rev. 28. pp. 1086–1107, Dec., 1926.—X-ray data show that the two assumptions usually involved in previous calculations of atomic radii from crystal structures —namely, (1) that the distance between adjacent atomic centres in crystals equals the sum of the two atomic radii, and (2) that the radii of atoms of the same element in different crystals are equal —in many cases cannot be correct. Assuming that a valence electron pair can be assigned a definite position and defining the atomic radius as the distance from the nucleus to a valence electron pair, it is evident that (1) is only true when there is a valence pair on the straight line joining the centres of the adjacent atoms, and (2) should be true, or nearly so, only when the atoms of the given element are structurally similar and similarly surrounded in the two crystals. The probable arrangements of valence electrons in crystals, as deduced elsewhere by the author, are used in deciding as to the validity of the above assumptions in particular cases. Comparable values of atomic radii have been calculated for a number of elements, in crystals in which atoms of these elements are each surrounded by four electron pairs at tetrahedron corners. Approximate radii of other elements similarly surrounded are obtained by interpolation and extrapolation. Radii are also calculated for certain elements in crystals in which each atom of these elements is surrounded by two, six, or eight electron pairs. The diameters of the hydrogen atom in six crystals are computed. AUTHOR.

893. *Mechanical Theories in Physics and Chemistry.* **A. Korn.** (Phys. Zeits. 27. pp. 801–803, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—On a mechanical theory an electromagnetic field can be produced only by oscillations of extraordinarily short period and of considerable inertia, such that the particles always retain their electric mass ; that would be without analogue in classical mechanics and would lead to the quantum theory. The oscillating particles would not radiate, nor would the electrons in their stable orbits, except when disturbed ; this view would accord with Bohr's, except that radiation would be caused by slight deviations from the orbit, not by jumps from one orbit to another, and that the stable orbits would not depend upon quantum relations. The restricting forces maintaining the orbits could for spectra (X-ray and others) be Coulomb forces; but these forces could not hold the nucleus particles together. The author suggests a nucleus consisting of particles *a*, *b*, *c*, the *a* appearing gravitational with respect to the outer field, the *b* and *c* electric; there would be repulsion between all the particles of the same kind, whether *a*, *b* or *c*, but attraction between the *a* and either *b* and *c*, and this attraction must be qualified by an absorption factor by virtue of which the attraction would turn into repulsion at greater distance. On these lines stable constellations are possible for all the atoms. H. B.

894. *New Element of Atomic Number* 61. **L. Rolla and L. Fernandes.** (Accad. Lincei, Atti, 4. pp. 498–499, Dec. 5, 1926.)—Commercial didymium is converted into the thallium double sulphates and is fractionally crystallised. During the control of this process by means of absorption spectra, a band attributed to praseodymium behaves abnormally, and the presence of a new element is suspected. This is confirmed by X-ray spectra. The name Florentium is proposed for this element. A. Wh.

895. *Existence of the Element of Atomic Number* 61. **Rita Brunetti.** (Accad. Lincei, Atti, 4. pp. 515–518, Dec. 5, 1926.)—Results of an examination of the absorption spectra of rare earths in the *k* region of high frequencies. For analysing the radiation a hard ray Siegbahn spectrograph was furnished with a lamina of rock-salt, which has a power of reflecting monochromatic X-rays four times greater than the calcite used by Siegbahn and Jönsson [see Abstract 1050 (1919)]. The radiation was produced by a deep therapy Coolidge tube kept in action under a tension of 100 kV with a current intensity of 2·5 mA. The limit of the continuous spectrum was thus near the radiation of a wave-length of 0·123 Å.U. The exposures lasted from two to four hours with a slit varying in width between two- and four-tenths of a millimetre. The registrations were made on Cappelli X-ray plates. The substance inserted in the path of the ray to be analysed was introduced in a celluloid container 0·3 mm. thick in the form of a very fine powder of about 0·7 gm. per cm.^{2}. The emission spectrum of tungsten type K at the antikathode of the tube served as a control. The samples of didymium oxide examined contained gadolinium, samarium, neodymium, praseodymium and lanthanum. Attention was concentrated on the spectral region between samarium and neodymium, where, at a distance of about 1 mm. from the neodymium band, almost all the photographs showed a discontinuity, which could only be interpreted as a true absorption band indicating the presence of the element in Mendelejeff's table between neodymium and samarium bearing the atomic number 61. A comparison of the wave-lengths of neodymium and praseodymium with the wave-length of this band confirms the conviction that the material examined contains a small percentage of the new element. E. F.

896. *Identification of the Element of Atomic Number* 61. **Rita Brunetti.** (Accad. Lincei, Atti, 4. pp. 518–521, Dec. 5, 1926.)—Further investigations with a somewhat modified procedure confirmed the conclusions recorded in the previous paper [see preceding Abstract]. The author claims that it is the first time the method of discontinuity of absorption has been used for discovering missing elements in Mendelejeff's table. Hitherto, following the example of Coster and Hevesy in the case of hafnium, recourse has always been had to the L emission spectra. E. F.

897. *Bohr's Model and the Supposed Coloration of Ions.* **G. Magnanini.** (Accad. Lincei, Atti, 4. pp. 530–532, Dec. 5, 1926.)—The author draws attention to a contradiction between his experiments, carried out many years ago and published in the (Gazz. Chim. 41. 2. p. 425), and the consequences of Bohr's theory of the constitution of atoms. His experiments, coordinated with Arrhenius' theory of the gradual and progressive dissociation of electrolytes, led to the rejection of the hypothesis of the coloration of ions, at that time generally accepted. The survival of this hypothesis in certain quarters is probably due to a tendency on the part of some investigators to consider chemical problems rather from a physical than from a chemical standpoint. Since by ionisation a profound change is to be understood in which the electron is transported out of its orbit towards infinity, it is evident that the intimate structure of substances in a state of dispersion is so changed by ionisation that their spectra must of necessity be modified. This is confirmed by experiments on gases and alkaline earth metals. Considering the case of aqueous solutions of coloured electrolytes in which ions are spontaneously formed by dissociation of the molecules, it is evident that a marked change in coloration should be observed. The author's experiments showed, however, that the dissociated part has always the same absorption spectrum as the non-dissociated. For coloured electrolytes, therefore, the consequences, which, according to Bohr's theory, should follow from the theory of Arrhenius, are not verified, seeing that ionisation leaves their absorption even quantitatively unchanged. Therefore either electrolytic dissociation is a spontaneous process, having nothing in common with true dissociation, in which case the theory of such dissociation should be modified, or the explanations of the intimate constitution of matter based on Bohr's theory are at variance with facts, in which case this theory should be modified. E. F.

898. *Collision Broadening of Spectral Lines and Sharpness of Quantum States.* **G. Hettner.** (Phys. Zeits. 27. pp. 787–789; Disc., 789, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—A method is discussed for obtaining the effect of collisions on the breadth of lines of the rotation and rotation-vibration spectra of gases, in the ultra-violet, by tracing the variation with density of the absorptive power. It is shown that the broadening of such lines is not to be explained as a Stark effect. The results indicate an effective collision diameter of the molecule, four to eight times that given by the kinetic theory of gases. In this case the explanation that the increase is due to the larger diameter of the electron orbit in the excited state is clearly not applicable. W. S. S.

899. *Adiabatic Invariance and Kinetic Energy in Undulatory Mechanics.* **E. Fermi** and **E. Persico.** (Accad. Lincei, Atti, 4. pp. 452–457, Nov. 21, 1926.)—Schrödinger's undulatory mechanics is shown to lead to an equivalent of the ordinary adiabatic principle. Expressions for kinetic and potential energy are also derived. Mainly mathematical. A. Wh.

900. *General Forms of Statistical Mechanics, with Special Reference to the Requirements of the New Quantum Mechanics.* **R. H. Fowler.** (Roy. Soc., Proc. 113. pp. 432–449, Dec. 1, 1926.)—This mathematical paper examines *ab initio* a quite general form of statistical mechanics of which the classical form and Einstein's and Fermi-Dirac's are special cases. The latter in particular is based on a discussion of lightly coupled systems with the help of Schrödinger's equation, and, combined with Heisenberg's work on the many-body problem [see Abstract 297 (1927)], demands a change in the classical form of statistical mechanics. The present author's investigation is rendered possible by using the powerful method of complex integration already applied to the classical form. The sequence of the argument is then to take the general form, which covers a very large range of ways of assigning possibilities and counting complexions, and construct on that basis exact integral expressions for the number of complexions possible to the assembly and for the average number of systems of the assembly in their various quantum states. From these the average energies and external reactions are derived and the definition of S and T. H. H. Ho.

901. *Maxwell's Equations and Atomic Dynamics.* **A. Bramley.** (Frank. Inst., J. 202. pp. 775–808, Dec., 1926. Nat. Acad. Sci., Proc. 12. pp. 653–657, Dec., 1926.)—This paper is entirely mathematical. The author opens it with the remark that in the solution of the problems of mechanics and electrodynamics the considerations involved are greatly simplified when the equations can be expressed in an invariant form as regards transformations of coordinates, and he gives examples. In the type of periodic motion considered in this paper, the value of a certain expression over a complete cycle fluctuates between the values P_4 and $-P_4$ for any given orbit, the average value of the expression being zero, and P_i is a function of position. In this type of motion, then, the amount of energy radiated while the electron completes a cycle in any given orbit is zero, so that radiation, or absorption, of energy occurs only when the electron executes a non-periodic motion. G. W. de T.

902. *An Undulatory Theory of the Mechanics of Atoms and Molecules.* **E. Schrödinger.** (Phys. Rev. 28. pp. 1049–1070, Dec., 1926.)—The paper gives an account of the author's work on a new form of quantum theory. § 1. The Hamiltonian analogy between mechanics and optics. § 2. The analogy is to be extended to include real " physical " or " undulatory " mechanics instead of mere geometrical mechanics. § 3. The significance of wave-length ; macro-mechanical and micro-mechanical problems. § 4. The wave-equation and its application to the hydrogen atom. § 5. The intrinsic reason for the appearance of discrete characteristic frequencies. § 6. Other problems ; intensity of emitted light. § 7. The wave-equation derived from a Hamiltonian variation-principle ; generalisation to an arbitrary conservative system. § 8. The wave-function physically means and determines a continuous distribution of electricity in space, the fluctuations of which determine the radiation by the laws of ordinary electrodynamics. § 9. Non-conservative systems ; theory of dispersion and scattering and of the " transitions " between the " stationary states." § 10. The question of relativity and the action of a magnetic field ; incompleteness of that part of the theory. AUTHOR.

903. *Quantisation of a Symmetrical Top according to Schrödinger's Undulation Mechanics.* **F. Reiche,** with a mathematical supplement by **H. Rademacher.** (Zeits. f. Physik, 39. 5–6. pp. 444–464, 1926.)—This problem is of importance in the theory of the band spectra of chemical molecules and of their specific heats; it is dealt with mathematically, and the resulting formula for the discrete values of the energy for the quanta differs from that of Schwarzschild and Epstein by the appearance of the combination $j(j+1)$ in place of j^2, as was expected. The quantum numbers of the total turning impulse differ from whole numbers by $\frac{1}{2}$. The disturbances due to an external field are dealt with to a first approximation. The paper concludes with some remarks on the heat of rotation of hydrogen; it seems necessary to assume that the turning impulse of the electrons about the axis of figure differs from unity. This would imply the existence of a magnetic moment, while hydrogen is diamagnetic. It is suggested that the electrons may have a spin in the contrary direction, such as to produce an opposite magnetic moment which compensates for the first. H. N. A.

904. *Wave Mechanics and Semi-Numerical Quantisation.* **H. A. Kramers.** (Zeits. f. Physik, 39. 10–11. pp. 828–840, 1926.)—This mathematical investigation deals with a method for the approximate solution of the Schrödinger particular function problems of an arbitrary system with one degree of freedom. It is shown in § 1 that the so-called semi-numerical quantisation represents a natural first approximation. § 2 contains an approximation formula for the graphical determination of the special functions. § 3 considers the connection of this method with that of the Brillouin and Wentzel systematic approximation process. § 4 investigates central motions and contains approximation formulæ for spectral problems. H. H. Ho.

905. *The Dynamical Equations of Mezscherski and the Motion of a Light Quantum.* **K. Schaposchnikow.** (Zeits. f. Physik, 39. 10–11. pp. 858–862, 1926.)—The accelerated motion of a light quantum is identified with the motion of a body whose mass changes continuously. The equations of motion of Mezscherski are applied to this case; also a kinematical basis is found for the idea of a limiting velocity. G. E. A.

906. *Particles in Wave Mechanics.* **W. Wessel.** (Ann. d. Physik, 81. pp. 1086–1090, Dec. 11, 1926.)—A solution of the Schrödinger wave equation appropriate to a particle moving in force-free space is developed by applying two Lorentz Transformations in turn to the spherical wave solution $\psi = \psi_0 \frac{e^{2\pi i\nu(t-r/u)}}{r}$, where $u = \frac{c^2}{v}$ and v is the velocity of the particle. The first Lorentz transformation contains the phase velocity u in place of the velocity of light c, and for the relative velocity has the particle velocity $+v$. The second transformation is strictly Lorentzian with the relative velocity $-v$. The solution in the final system of coordinates which move with the "origin" singularity corresponding to the particle takes the form $\psi = \psi_0 \frac{\exp 2\pi i \frac{m_0c^2}{h} t'}{r'\sqrt{1-\frac{v^2}{c^2}}}$, representing an oscillation with frequency $\frac{m_0c^2}{h}$, and phase independent of position. The relation of this result to the "periodic phenomenon" of de Broglie is discussed. W. S. S.

907. *On Equilibrium and Motion of a Continuous Medium in Four Dimensional Space.* **D. Meksyn.** (Phil. Mag. 2. pp. 994–1006, Nov., 1926.)—Derives the equation of continuity and the general conditions of equilibrium and motion of a continuous medium, and applies the results in deriving the dynamical laws of an electromagnetic field, which is regarded as a particular instance of a mechanical system. The dynamics of the electron must be based, not upon any assumption about its form, dimensions or other properties, but mainly on the dynamical laws of the electromagnetic field. The mathematical treatment leads to the conclusion that radiation from an electron in continuous motion is incompatible with the mechanical equilibrium of the electromagnetic field. A discontinuous change of velocity of an electron, such as that produced by a collision is accompanied by heat generation The analytical expression which represents the energy relation when heat is absorbed or emitted and the force is not normal to the track can be applied not only to an electron, but to a finite piece of matter; the physical phenomenon is, however, different in the two cases. In the electron absorption or emission of heat are accompanied by increase or decrease of the velocity respectively; with a material body absorption of heat goes on through its electrons or protons, and the velocity of the body as a whole remains unchanged. Heat is not a result of continuous motion of molecules. At the absolute zero only continuous motion is possible. H. N. A.

908. *A Refinement of the Michelson-Morley Experiment.* **R. J. Kennedy.** (Nat. Acad. Sci., Proc. 12. pp. 621–629, Nov., 1926.)—A refinement of the Michelson and Morley experiment, in which the light paths were reduced to about 4 metres, and the optical system was enclosed in a sealed metal case containing helium, whereby disturbing effects due to changes in the density of the gas were reduced to one-tenth of their magnitude in air, is described. The high sensitivity necessary, because of the short optical paths, is secured chiefly by the device of raising one-half of the surface of one of the mirrors a small fraction of a wave-length above the other. The experimental method is based upon the condition determining equality of illumination of the fields viewed in the two halves of the mirror. The apparatus was capable of detecting a shift of the fringe system equal to one-fourth of that found by Miller. No such shift depending on orientation was found. A repetition at Mount Wilson Observatory also yielded negative results. J. S. G. T.

909. *Theory of Universal and Discontinuous Action.* **R. Lévi.** (Comptes Rendus, 183. pp. 865–867, Nov. 15, 1926.)—Electromagnetic theory is developed in terms of a theory of universal action, in which every particle in the universe acts upon every other, the elementary actions being propagated with the velocity of light. Quantum theory is included in the theory by assuming that matter is composed of elements having no volume, whose trajectories are broken lines. The intervals between discontinuities in the trajectories are equal, and definite amounts of action characterise the passage of a particle through a discontinuity.

J. S. G. T.

910. *The Atom in the Theory of Universal and Discontinuous Action.* **R. Lévi.** (Comptes Rendus, 183. pp. 1026–1028, Nov. 29, 1926.)—Atomic theory is developed briefly along the lines of the discontinuities referred to in an earlier paper [see preceding Abstract]. J. S. G. T.

911. *Electromagnetism in World Geometry.* **E. Reichenbächer.** (Phys. Zeits. 27. pp. 741–745, Nov. 15, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—Various theories relating to the place of electromagnetism in the scheme of world geometry are critically and briefly reviewed. J. S. G. T.

912. *Motion of an Electron in the Field of a Fixed Centre allowing for the Mass Change due to Radiation. Part II.* **M. Bronstein.** (Zeits. f. Physik, 39. 12. pp. 901–907, 1926.)—In answer to Kudar's criticism of the author's earlier paper [see Abstracts 1252 and 2540 (1926)], it is here shown that the equations of motion of the electron obtained by taking into account the variation of rest-mass with position form a special case of a certain tensor equation satisfying the relativistic transformation laws of a covariant tensor. It is concluded that the criticism of Kudar fails to hold. W. S. S.

913. *Motion of Uniform Translation and Some Questions Connected Therewith.* **E. Brylinski.** (Rev. Gén. d'Él. 20. pp. 979–990, Dec. 25, 1926.)—The question of motion relative to an ether is re-investigated mathematically, and reference is made to the absence of radiation from an electron describing a Bohr orbit and to the quantification of spectral energy. Miller's conclusions from the results of the Michelson experiment carried out at Mount Wilson are considered to be at least partly contestable. The experiment stands in need of repetition at different altitudes and in various latitudes before definite conclusions can be reached. J. S. G. T.

914. *A Possible Way to Discuss the Fundamental Principles of Relativity.* **P. Slavenas.** (Nat. Acad. Sci., Proc. 12. pp. 739–745, Dec., 1926.)—It is shown *inter alia* that Euclidean space admits the law of uniform translation of a rigid system relative to another, the moving system undergoing contraction in the direction of motion. J. S. G. T.

METEOROLOGY AND GEO-PHYSICS.

915. *Atmospheric Pollution in Leeds during* 1922–25. **B. A. Burrell.** (Leeds Philosoph. and Lit. Soc., Proc. 1, pp. 116–122, Oct., 1926.)—The results are given of periodic measurements made in and around Leeds by means of a soot gauge of the amount of solid matter deposited from the atmosphere. The gauge consists of a circular stoneware basin with a conical base and communicating by means of a brass tube with a bottle of capacity of 5–6 litres, capable of holding one month's rainfall. The rain and deposited matter collected are removed monthly for analysis. The products identified and estimated include tar, ash, ammonia, sulphates, nitrates and arsenic. J. N. P.

916. *Relation between the Temperatures of Certain Months of the Year.* **L. Besson.** (Comptes Rendus, 183. pp. 802–804, Nov. 8, 1926.)—The fluctuations from year to year of mean monthly temperatures at a number of stations have been investigated. There is a close similarity between the April and July sequences and the curves are roughly parallel if the July records are retarded by approximately seven years. Correlation coefficients between the mean temperatures of April and of July seven years later are: Paris (1803–1926), 0·404; Paris (1851–1926), 0·362;

Strassburg, 0·364; Nantes, 0·352; Geneva, 0·320; Vienna, 0·245; Greenwich, 0·201. The Paris data also indicate weaker correlation between the temperatures of May and December eight years later, and an inverse variation between November and January six years later.

A. W. L.

917. *Inter-Relations of Pressure Anomalies over the Earth.* **F. M. Exner.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 7–8. pp. 333 355, 1926.)—The author tabulates as in a previous paper [see Abstract 1836 (1925)] the mean monthly pressure anomalies for the winter and summer half-years for seventy-one stations scattered over the world. The pressure at Obdorsk is correlated with the other places, and a region between 40° and 60° N. quite round the earth has with this place almost a zero correlation. Eight stations on or near this area are chosen and their pressure anomalies for the winter half-year correlated with the whole of the seventy-one stations. A shorter method of arriving at the results is then examined, using an extreme positive or negative anomaly at each of the eight selected stations and finding the corresponding values for all the others. The results are exhibited in a series of charts and explained in detail. The method gives the influence of abnormal pressure at one place on the pressure at other parts of the earth. The possible dynamical and thermal considerations which may produce these results are examined and applied in several cases. Polar regions are mostly places of maximum influence, while southwards over the sea there are also places of large correlation. Continental regions have a small influence. Next, assuming particular anomalies at two selected stations, the author considers how the average pressure distribution is produced, and gives tables and graphs of his tests for six combinations of two places in the northern hemisphere when their pressure anomalies are of the same sign, and of opposite sign, using again the winter half-year. For a clearer picture of the origin of the pressure distribution over the earth a longer series of observations than thirty years would be necessary, and combinations of pressure anomalies at three places should then be taken, with also due consideration to the temperature anomalies. R. S. R.

918. *Primary and Secondary, Free and Forced Pressure Waves in the Atmosphere.* **A. Defant.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 7–8. pp. 357–377, 1926.)—Ficker has already dealt with the structure of compound depressions [see Abstract 1690 (1921)], and the author develops these ideas. Consideration is given to the movement of a disturbance originating as a sudden pressure disturbance and moving eastwards as a pressure wave, while its effect at different heights is given by an advective effect of air masses of different temperatures. Mathematical relations are established for the system. To illustrate the relations a trough of low pressure is examined and a solution found for the pressure at any surrounding point subsequently. The trough resolves itself into a series of high and low pressure regions moving eastwards, usually increasing in intensity to a maximum and then dying away. A numerical example is taken and the sequence of changes illustrated by diagrams. The actual stage at any time depends upon the relative position of the upper primary pressure wave and to the forced pressure wave at the surface. The depression continues to deepen while its axis is inclined westwards, the trough of the primary wave being west of that of the surface-pressure oscillation. The growth ceases when the upper wave catches up with the surface wave, and with a reversal of the slope of the axis the depression dies out. The actual development of these pressure oscillations depends upon the extent to which the primary upper pressure wave is in keeping with the given structure of the troposphere. Finally, remarks are made upon the spatial symmetry of weather charts, and the results obtained by Weickmann are discussed with reference to the theories developed in the paper. R. S. R.

919. *Pressure Waves and Correlation over the North Atlantic Ocean.* **A. Schedler.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 7–8. pp. 379–393, 1926.)—The paper forms a continuation of the work of Defant on pressure waves [see Abstract 1261 (1926)], using more recent observations and detailed synoptic charts for the North Atlantic Ocean over the three months December 1906 to February 1907. Ten-degree squares were employed over almost the whole area from 80° W. to 40° E. and 20° N. to 75° N. Isallobaric charts for twenty-four hours were constructed for each of the ninety days, pressure waves of long period being eliminated in the day-to-day change. A general movement from west to east was thus found. Correlation coefficients for the daily pressure changes at a point in Iceland with those in each of the squares were found and charts drawn to give lines of equal correlation. From theoretical considerations, if the waves of pressure progress, the regions of largest and smallest correlation should remain fixed, and this was confirmed by correlating the 10° squares with four other points in turn and drawing the corresponding charts with lines of equal correlation. The progress of waves over the region was further analysed by correlating the pressure changes with those a day later for the same point, and although the observations are different for place and time, the results agree well with those of Weickmann. In agreement with theory waves of short period are found, while the progress of this time correlation was used to analyse the progress of the pressure wave.
R. S. R.

920. *Present Condition of Knowledge on the Composition of Meteorites.* **G. P. Merrill.** (Am. Phil. Soc., J. 65. 2. pp. 119–130, 1926.)—The results of many analyses have shown that meteorites come from a basic group of rocks, mainly peridotites, with an elemental composition essentially the same as allied terrestrial rocks but with a deficiency of oxygen. The presence of some doubtful elements was confirmed, but others were not found, while a few were found in traces for the first time. The percentages of various gases in stony and iron meteorites are given, while other tables show the geographical distribution in North America, and the annual falls, geographical distribution, and number of siderites, siderolites and aerolites over the world. No signs of animal or vegetable life have been found in meteorites, and all are of volcanic material, while their absence from all but most recent geological deposits indicates that if any fell earlier they were of a different type, or have decomposed and become unrecognisable. R. S. R.

921. *Detection of Micro-Tremors by Oscillating Triodes.* **J. Obata.** (Imp. Acad. Tôkyô, Proc. 2. pp. 405–409, Oct., 1926. In English.)—The author has previously dealt with the use of oscillating valve circuits as a means of measuring small displacements with a view to the precise recording of sounds. In this article the use of a similar apparatus is described for the purpose of measuring earth tremors and similar types of disturbances. A condenser is formed by a surface of mercury and a flat steel plate supported just above it. Another condenser system, one of the plates of which was carried by a horizontal pendulum, was used for the measurement of oscillations of the pulsatory type. These condensers, whose capacity varies with the vibrations, are connected to the triode circuit, thus enabling these small changes of capacity to be observed and recorded if desirable. F. S. B.

922. *Elasticity and Temperature of the Material in the Interior of the Earth.* **H. Nagaoka.** (Imp. Acad. Tôkyô, Proc. 2. pp. 484–488, Nov., 1926.)—Calculation of the elastic constants for the interior of the earth, using Knott's investigation [see Abstract 690 (1919)], shows that the bulk modulus, compressibility, rigidity, Poisson's ratio and the velocities of the dilatational and distortional waves have a marked discontinuity at a depth of 1550 km. This agrees with the depth found by Weichert. This abrupt change will produce a great effect on the amplitude of seismic waves, while the distortional wave can be followed much deeper than the dilatational wave. Further, on account of the high temperature of the interior the viscosity is much increased and short waves are gradually damped down. The author disagrees with Knott's idea of a gaseous core. From values for the linear coefficient of expansion, bulk modulus and pressure at any depth, the corresponding temperatures are found as 4000° C. at 3500 km. from the centre and 4800° C. at 3000 km. If, further, the same relations between these quantities hold at high temperature and pressure, there is no necessity for considering the interior of the earth to consist mainly of Fe and Ni. R. S. R.

923. *Near Earthquakes.* **H. Jeffreys.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 385–402, Dec., 1926.)—Temperature considerations lead to a depth of the granitic layer of 15 km. The author examines the data for several seismic disturbances observed at short distances, and finds for the velocity of compressional waves in the granitic layer 5·6 km./sec., in the ultra-basic layer 7·8 km./sec., and in the basaltic layer 6·2 km./sec. For distortional waves the velocities in the granitic and basaltic layers are 3·2 km./sec. and 4·3 km./sec. with an error for all values not exceeding 0·1 km./sec. The thickness of the granitic layer is 12 km. and of the basaltic layer 25 km., with an accidental error of 4 km. It is concluded that results concerning the depths provided by near earthquakes are not more accurate than the single datum provided by thermal considerations. In the granitic and basaltic layers the velocity appears constant, but it increases with depth in the lower layer so as to indicate no further great change of material down to a depth of 1200 km. Results obtained from the Oppau explosion indicate that the transitions are continuous. R. S. R.

924. *Viscosity of the Earth.* **H. Jeffreys.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 412–424, Dec., 1926.)—Values have been deduced from seismological considerations of the maximum elastic after-working of the earth rocky shell and of the viscosity of the core. The plasticity of the lithosphere is small or zero, corresponding to a time of relaxation of rigidity of at least 3×10^7 years. By considering variations of latitude some positive indication is given that the time of relaxation in the rest of the rocky shell is slightly more than two years. The origin of the moon and Wegener's theory of continental drift are examined. This continental drift is not capable of giving important distortion of the lithosphere during geological time, but might give appreciable bodily displacement of the lithosphere over the interior. Osmond Fisher's theory of the formation of the moon from a resonance effect of the semidiurnal tide is examined, and it is shown that a region stripped of granitic material by the separation of the moon would probably persist, though the theory does not harmonise immediately with the present distribution of the continents. R. S. R.

925. *Revised Seismological Tables and the Earth's Liquid Core.* **H. H. Turner.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 425–446, Dec., 1926.)—Early deductions regarding the earth's interior were rendered doubtful by uncertainties in the observations, imperfections of the early instruments, difficulties regarding accuracy of time at the stations, and doubts regarding the precise phenomena recorded on the seismograms. Since 1918 these difficulties have been largely avoided, and the tables for P and S, adopted for use in the International Seismological Summary, have been compared with observations for a number of years, particularly 1918–1922. The residuals have been collected and tabulated and the results discussed for epicentral distances less than 120°. Striking phenomena regarding the Gutenberg S_cP_cS wave and another which is probably the P[S] wave are obtained. In the tables of residuals for S dual maxima are found, and this probably occurs also for P. It is stated that if the earlier maximum is the true P (or S), then the tables are in error in this region, and, when corrected, the rate of change of P would show the maximum which puzzled Galitzin in his measurements of the angle of incidence. R. S. R.

ASTRO-PHYSICS.

926. *Fundamental Longitude Determinations.* **C. Lallemand.** (Comptes Rendus, 183. pp. 765–768, Nov. 8, 1926.)—A description of the international longitude determinations, which aim at fixing with the highest possible accuracy the longitudes of three stations of approximately the same latitude and distributed at about 120° from each other. The stations chosen are Algiers, Shanghai and San Diego. Other stations will also be included in the scheme as secondary points. Local time will be determined with transit instruments and with a prism astrolabe, and it is hoped that comparisons of the results will enable certain systematic errors to be eliminated. The coordination of the local times will be by wireless signal, which will be automatically recorded. A. Wh.

927. *Rotation of Heterogeneous Masses.* **A. Veronnet.** (Comptes Rendus, 183. pp. 949–951, Nov. 22, 1926.)—A fluid mass may rotate either as a rigid body or in a series of cylindrical shells, each shell rotating as a unit. A mass rotating as a rigid body will tend to form an equatorial ring. It is considered that the rings of Saturn could not have been derived directly from the planet, but must have been formed from a satellite or a captured body. The possibility of rotation in cylindrical zones explains the bands on Jupiter and Saturn and the formation of sunspots. Such rotation is bound to set up turbulent conditions on the surface. A. Wh.

928. *Structure of the Chromosphere.* **L. d'Azambuja.** (Comptes Rendus, 183. pp. 1023–1025, Nov. 29, 1926.)—Earlier observations on the structure of faculæ as shown by spectroheliograms taken with different settings of the H and K lines of calcium and $\lambda\lambda$4046, 4384 of iron have been supplemented by observations on the λ4227 of calcium and $\lambda\lambda$3838, 5184(b_1) of magnesium. A. Wh.

929. *Motion of Metallic Vapour in Sunspots.* **G. Abetti.** (Accad. Lincei, Atti, 4. pp. 242–246, Oct., 1926.)—A number of spectrograms taken during 1926 are recorded. The velocities have been reduced using pairs of plates [see next Abstract]. Velocities up to the very high value of 6·5 km. per second are shown, and St. John's observation that the velocities indicated decrease with increasing intensity of the spectral lines employed is fully confirmed. A. Wh.

930. *Evershed Effect in Sunspots.* **R. Mancinelli.** (Accad. Lincei, Atti, 4. pp. 276–282, Oct., 1926.)—In observations of the radial velocities by spectroscopic measurements on sunspots, both the velocity of the gas in the reversing layer and the angle of the flow with the horizontal are determined by combining two observations. Calculated results are given for observations on a sunspot on April 3 and 7, 1915. A. Wh.

931. *Photographic Determinations of the Position of the Moon.* **Charlotte E. Moore.** (Harvard Coll. Obs. Annals, 85. pp. 169–179, May, 1926.)

932. *Changes on the Surface of Mars.* **Jarry-Desloges.** (Comptes Rendus, 183. pp. 1025–1026, Nov. 29, 1926.)—A record of the changes in the surface appearance of Mars noted during the opposition of 1926. More changes took place during this opposition than have been observed previously. A. Wh.

933. *On Delaunay's Method.* **H. Andoyer.** (Comptes Rendus, 183. pp. 1069–1071, Dec. 6, 1926.)—Application of Delaunay's method to the theory of the moon. Continuation of a previous paper [see Abstract 595 (1927)]. E. F.

934. *Absolute Magnitude and Proper Motion.* **K. G. Malmquist.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19. No. 19. pp. 1–32, 1926. In English.)—Experimentally established formulæ for the relation between absolute magnitude and proper motion are discussed, and then a relation is derived from theoretical considerations of a generalised Maxwellian distribution of velocities following Fange. A relation is also derived on the lines indicated by Schwartzschild, where the logarithms of the tangential velocities are supposed to be given by a normal error distribution. A. Wh.

935. *Three Peculiar Spectra.* **J. S. Plaskett.** (Roy. Astron. Soc., M.N. 87. pp. 31–34, Nov., 1926.)—These three stars, υ Sagittarii, H.D. 50820, and H.D. 45910, have a fundamental spectrum of type B_2 or B_3, but with a many-lined metallic spectrum of type A_2, superposed on it; their hydrogen lines are like novæ in being partly emissive and variable. In addition, υ Sagittarii shows all the lines of α Cygni, having the "*c*" characteristic supernormal, indicating high luminosity and low density in both the metallic and helium spectrum; both are sharp, strong and with identical velocity displacement in all orbital phases, pointing to a single stellar atmosphere; in the hydrogen spectrum, the absorption components are always displaced to the violet side of the primary absorption, and never to the red, and are independent of orbital motion, showing their single stellar origin, and also disproving Ludendorff's enormous masses, for the supposed pair, of 260 and 54 times that of the sun, H.D. 50820 is probably somewhat similar in constitution to υ Sagittarii. H.D. 45910 has P Cygni emission and absorption lines of hydrogen, showing a cyclic change of 120 km. in 235 days, the absorption lines becoming almost a replica of α Cygni on four separate occasions. [See also Abstract 327 (1927).]

A. S. D. M.

936. *Pokrowsky's Proposal for Determining Angular Diameter of Stars.* **A. S. Eddington.** (Roy. Astron. Soc., M.N. 87. pp. 34–36, Nov., 1926.)—This method of determining stellar diameters by elliptically polarised light has a flaw, since it assumes that the centre of a stellar disc will contribute zero intensity to the image, while points in the periphery distant only 0″·003 (for a first magnitude star) give observable brightness. This involves incredible delicacy of displacement, and is impracticable in theory, since there is no means for decision whether the image intensity indicates a stellar radius of 0″·003, or a point source viewed 0″·003 out of alignment. Actually with displacement the star would not pop in or out, but bright and dark interference bands would pass across the point in the focal plane as with the Michelson interferometer. The author shows how the fallacy arose.

A. S. D. M.

937. *Internal Densities and Temperatures of Stars.* **J. H. Jeans.** (Roy. Astron. Soc., M.N. 87. pp. 36–43, Nov., 1926.)—The author disagrees with Eddington in taking λ (ratio of gas-pressure to radiation-pressure) as constant throughout the star, and has calculated it afresh [see Abstract 1599 (1925)], finding that it varies as $T_c^{\frac{1}{4}}$ and $T_c^{\frac{1}{3}}$ for stars of very small and very great mass, and that their densities vary as T^n, where n has the extreme values 3·25 and 7 respectively. Where energy is generated uniformly throughout the star, he obtains the equation

$$n = 3 + (4 + \lambda)/(1 + 4\lambda),$$

and thereby tabulates the central densities and temperatures of various stars indicating that these are very much higher than has been generally supposed. He therefore disagrees with H. N. Russell [see Abstract 2244 (1925)]. He discusses an alternative suggestion that the main sequence is determined by the condition that a substantial fraction of the atoms near a star's centre are stripped of electrons and have therefore ceased to generate energy. He consequently considers the case where energy is not generated uniformly throughout the star, but principally away from the star's centre; the main generation of energy being confined to temperatures between T_c and $\frac{1}{3}T_c$. In such a case for a star of very small mass, n becomes 3·75 and not 3·25, and the values of ρ_c must be increased nearly fourfold, and of T_c by 40 %. For more massive stars the increases are incomparably greater: for the sun, T_c would be 100 million degrees, and for V Puppis 400 million, or perhaps 4000 million degrees.

A. S. D. M.

938. *Stellar Parallaxes determined at the Royal Observatory, Greenwich.* (Roy. Astron. Soc., M.N. 87. pp. 61–63, Nov., 1926.)—A list of the parallaxes of twenty-six stars between photographic magnitudes, 6·7 and

11·9, made with the Greenwich 26-in. telescope, in continuation of those published annually in the November number of the Monthly Notices since 1920. **A. S. D. M.**

939. *Stellar Magnitude Scales of Astrographic Catalogue. 20th Note. Sydney Magnitudes for* − *52° and Melbourne Magnitudes for* − *65° and* − *67°.* **H. H. Turner.** (Roy. Astron. Soc., M.N. 87. pp. 64–75, Nov., 1926.)—The Sydney magnitudes are in two series from plates taken some twenty-eight years apart: H. C. Russell's *old series* were measured in four different machines (Repsold I and II, and machines "slide" and "comb"); W. E. Cooke's *new series* in two machines (Sydney A and B). The author examines the measure by these six instruments; he points out that the average number of stars measured in Repsold I is 428, and in Sydney A is only 230, and that the reduction of the exposure times (from 6 m., 3 m., 20 s. to 4 m., 2 m., 13 s. respectively) scarcely accounts for this difference. There is some difficulty in coordinating the various estimates of magnitude, and in analysing the results harmonically after making approximate correction for galactic condensation; practically there is no agreement in the comparison of prediction with observation. Therefore two Melbourne zones are also analysed and give better accordance than the Sydney zones, though still leaving much to be desired. It seems probable that the absence of zones near the South Pole has made an essential difference to the analysis. **A. S. D. M.**

940. *Fundamental Equations of Planetary Motion.* **W. M. Smart.** (Roy. Astron. Soc., M.N. 87. pp. 76–93, Nov., 1926.)—In the first part of the paper the author obtains certain relations amongst the derivatives of the disturbing function, with respect to the six elliptic elements; in the second part he employs these relations to derive the six well-known equations of planetary motion. The treatment is wholly mathematical. **A. S. D. M.**

941. *Spiral Form and Stellar Development of the Andromeda Nebula.* **J. H. Reynolds.** (Roy. Astron. Soc., M.N. 87. pp. 112–114, Dec., 1926.)—Hubble's work on the Andromeda Nebula has given us a definite indication of its distance and dimensions. It is probably the nearest of the spiral nebulæ, but, owing to the high inclination of its plane to the line of sight, the spiral development is difficult to follow in photographs. Assuming that the nebula is really roughly circular, a comparison of the minor and major axes of the apparent ellipse show that the inclination is about 70°, and if the two-dimensional image be projected at the corresponding angle the projection should give an approximate idea of the real spiral form, since we know from edge-on examples of spirals that the third dimension need not be seriously considered in regions away from the nucleus. A photograph of the nebula taken in this way is here given, and shows that it is of massive type with arms of considerable breadth; it is developed through almost a complete revolution of the spiral, and one arm is much more irregular than the other. The amorphous character of the nucleus and surrounding regions is evident, in strong contrast with the outer stellar regions, and this is confirmed by star counts. The small globular nebula N.G.C. 221 is probably in the same plane and connected with one of the arms, and since its radial velocity has been found by Slipher to be the same as that of the principal nebula, the two are evidently intimately connected. The star counts were made on Ritchey's photograph taken at Yerkes, and a diagram shows some of the results. Counts made on Hubble's photograph indicate that there are ten times as many stars at the extremities of the ellipse as in regions near the centre. M. A. E.

942. *Proposed Spectroscopic Method for Determining the Absolute Luminosities of Class A Stars.* **Ching-Sung Yü.** (Lick Observat., Bull. 12. No. 380. pp. 155–164, 1926.)—The spectroscopic parallax method of Adams, successful with stars of types F to M, cannot in general be applied to A stars. This is probably due to the large temperature range within any subclass of early-type stars. Adams and Joy attempted to correlate the absolute magnitude with the subdivisions of class A, and Lindblad with the relative intensity of different regions of the continuous spectrum; but neither of these methods is quite satisfactory. A new criterion is here tentatively suggested, namely, the intensity of the continuous hydrogen absorption which begins abruptly near the limit of the Balmer series lines and extends far into the ultra-violet. Although no simple relation can be traced between this intensity and the absolute magnitude, if temperature be also taken into consideration the absolute magnitude can be found. The fundamental data have been taken from thirty-nine A-type stars whose trigonometrical parallaxes are known, and whose temperatures had been determined by the author (see Lick Observat., Bull. 12. 104, 1926), and a table is given of sixty-three stars, including these, with the absolute magnitudes derived by this new method, and the parallaxes deduced therefrom. The spectroscopic parallaxes of Joy and Adams, and the trigonometrical and group parallaxes from Schlesinger's Catalogue, are also listed for comparison whenever available. The method, like the others, depends ultimately upon the degree of ionisation in each star; its significance for the theory of ionisation, and its advantages and limitations are pointed out. M. A. E.

943. *Henry Draper Extension.* **Annie J. Cannon.** (Harvard Coll. Obs. Annals, 100. pp. 17–32, 1926.)—The spectra of 3000 stars are given, of which the first thousand are in continuation of Vol. 100. No. 1 [see Abstract 2946 (1924)], being the stars classified in the Cygnus Cloud. The other 2000 stars are contained in 128 square degrees of the Aquila-Sagitta portion of the Milky Way. The author draws attention to peculiarities in forty-four stars. A. S. D. M.

944. *Constants of Star Streams from Photographic Proper Motions of 3029 Stars.* **W. M. Smart.** (Roy. Astron. Soc., M.N., 87. pp. 122–138, Dec., 1926.)—A comparison of plates (photographed through the glass) taken lately with the Sheepshank's equatorial of 19·3 focal length, with those taken for parallax between 1900 and 1906 by Hinks and Russell. Direct comparison was made of the positions of a stellar image by placing the plates film to film. The 3029 stars are formed into eight groups, and the numbers of stars are counted for each region whose absolute proper motions lie in each of the thirty-six position-angle sectors of 10°. The magnitudes of the stars lie roughly between 8 and 12, and only 12 % of them have proper motions exceeding 4" per century, and the probable errors do not, on the average, exceed 0"·4 per century. The author follows

Eddington's method for analysis of the frequency curves into two drifts, tables and graphs of the eight groups being given. He obtains for the coordinates of drifts I and II respectively, R.A. of Apex., 88°·4 and 289°·0, and Dec., − 11°·8 and − 73°·3; he compares these with the values obtained by Kapteyn, Eddington, Dyson and Bruggencate, the most noticeable difference being the high declination of his apex for drift II. For the vertex of star streaming, he gets R.A., 91°·7 and Dec., + 19°·9, or, in galactic coordinates, G. 158°·5, g. + 2°·4; indicating that the axis of star streaming is near the galactic plane. Drift I contains 1537 stars; drift II, 1452; and the R.A. and Dec. of the solar apex are 273°·2 and + 43°·6, that is higher than for bright stars. None of Oort's category of high-velocity stars is found. [See next Abstract.]
A. S. D. M.

945. *Analysis of Cambridge Proper Motions.* **A. S. Eddington.** (Roy. Astron. Soc., M.N. 87. pp. 138–142, Dec., 1926.)—The author compares his own analytical with Smart's trial and error method, as a check on the element of "judgment," whether automatic or human, which must be exercised. He finds that the two methods give reasonably accordant positions of the vertex, but that its *h*V (the relative velocity of the two streams) is 20 % lower by the analytical method, and that this is systematic. The automatic "judgment" tends to assign less separation to the two streams than the conscious judgment of the curve-fitter. In probable accuracy of result, the trial and error has a distinct advantage, justifying the additional labour involved; the automatic method which dispenses with human judgment does not reach the same delicacy. Smart's results (for magnitudes 8 to 12) are compared with Boss's bright stars, and it is found that both for solar motion and for star streaming the bright and faint stars give the same value for *hV*, though intrinsically fainter stars—whose peculiar velocities have been esteemed larger—must be included in Smart's stars. The increase in the proportion of stars in drift II with increasing faintness has been suspected and is confirmed by the Cambridge stars, and this is reflected in their higher declination of the solar apex. This high vertex is likely to be typical of stellar motions in general. [See Abstract 1600 (1908) and preceding Abstract.]
A. S. D. M.

946. *Star Streaming and Structure of the Stellar System.* **B. Lindblad.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19. No. 21. pp. 1–8, 1926. In English.)—The stellar system is considered to have a structure consisting of a series of spheroids with the same diameter in the galactic plane but their minor axes, perpendicular to this, decreasing with increasing star density and angular velocity. Viewed then from a star such as the sun, which is a member of one of the inner zones, the stars will appear to have an asymmetrical drift such as has been studied by Strömberg. The equilibrium of such a system is considered and a relation obtained between the dispersion of the velocities and the asymmetrical drift, which agrees in form with that obtained by Strömberg and gives for the total mass of the stellar system 180×10^9 solar masses. The sun appears to lie not far from the limiting surface of the system. The distribution of certain spectral types and of nebulæ in the outer zones and the effect of local concentrations of mass in the Milky Way on star streaming are also discussed.
A. Wh.

947. *Star Streaming and the Structure of the Stellar System. The Globular Clusters.* **B. Lindblad.** (Ark. f. Mat., Astron. och Fysik, Stockholm, 19. No. 27. pp. 1–8, 1926. In English.)—In another paper [see preceding Abstract] the structure of the stellar system is considered to be made up of a series of spheroids of common radii but with varying minor axes, the spheroids with the smaller minor axes having the higher angular velocities and densities. The spheroid consisting of the globular clusters is here considered. The gravitational force acting on the component clusters can be treated as that due to the whole mass of the system concentrated in the inner zones. The equilibrium is considered and compared with Shapley's data. The avoidance of the galactic plane is possibly due to the preponderating effect of collisions there which will tend to increase the inclination of the orbits to that plane. The estimate of the mass of the stellar system derived from these considerations is 1·4 times as large as that derived in the previous paper. A. Wh.

948. *Internal Movements and Stratification of Stellar Bodies.* **R. Wavre.** (Arch. des Sciences, 8. pp. 330–336, Nov.–Dec., 1926.)—In the case of bodies such as the sun, Saturn and Jupiter, it is known that the period of rotation varies with the latitude. From hydrodynamical considerations and imposing the condition assumed by other workers that gravity acts at each point normal to the surfaces of equal density, it is shown that the angular velocity depends only on the distance from the axis. A spherical distribution of temperature will not affect this, and it is considered that the effect of viscosity will be small. The equilibrium of a homogeneous fluid mass at rest, of the same rotating about an axis, and of a heterogeneous rotating body is considered. A. Wh.

949. *Stellar Structure.* **J. H. Jeans.** (Nature (Suppt.), 118. pp. 29–40, Dec. 4, 1926. Lecture delivered at Univ. Coll., London, Nov., 1926. Roy. Astron. Soc., Canada, J. 21. pp. 7–34, Jan., 1927.)—The development of astrophysical theories is outlined to the present time, and attention is then concentrated on the problem of the generation of energy in stellar interiors. Investigations of the equilibrium of the materials composing a star lead to the conclusion that there will be no convective mixing of the different layers and that consequently the heavier atoms will tend to concentrate at the centre. This in turn demonstrates the probability that the generation of stellar energy is dependent on the presence in the star of atoms of greater mass than are known terrestrially. It is shown that the rate of evolution of energy is apparently more immediately connected with the age of a star than with any other quantity. The existence of a critical central temperature is discussed, and it is suggested that this corresponds to the temperature at which the central atoms are completely stripped of electrons and that such stripped atoms are incapable of being degraded or annihilated with evolution of energy. This is conceivable on the theory that annihilation represents the fall of an electron into a zero quantum orbit. The penetrating radiation recently demonstrated may represent the primary energy radiation from nebulæ. From such bodies it can escape unchanged while in stars, though initially present, it is successively absorbed and re-emitted until its frequency is so lowered by the Compton effect that it ultimately escapes from the surface of the star as radiation in the ordinary spectral range. A. Wh.

950. *Stellar Temperature and Ionisation.* **E. A. Milne.** (Nature, 118. pp. 738–740, Nov. 20, 1926. Substance of lecture delivered to the Manchester Lit. and Phil. Soc., Oct., 1926.)—A recapitulation of recent astrophysical advances. Saha's theory is described and the temperature scale derived by Payne from considerations of absorption line maxima and ionisation equilibria. A very recent development of promise is the method devised by Yü where the continuous absorption associated with the limit of the Balmer series is measured on the same spectrum plate as the colour-temperature, these two quantities together enabling the absolute magnitude to be determined. A. Wh.

951. *Ionisation Equilibrium in Stellar Atmospheres and in the Earth's Atmosphere.* **A. Pannekoek.** (K. Akad. Amsterdam, Proc. 29. 9. pp. 1165–1171, 1926.)—Equations relating to ionisation in the atmosphere of stars and of the earth are first derived from the conditions of radiative equilibrium, and these are applied to obtain the distribution of ions over the various layers. The results for H_2, O_2, and N_2 are tabulated to show the number of electrons per c.c. for different pressures and heights. Generally the number increases at first regularly, reaches a maximum between 100 and 1000 km., and then falls rapidly to zero with increasing absorption. The numbers agree well with results obtained from wireless experiments, but the lower limit is found at a greater height than is sometimes stated. Reasons are given for considering that the temperature of the upper layers is lower than is usually assumed. Further, since the existence of a hydrogen atmosphere above the nitrogen and oxygen atmosphere makes the existence of a Heaviside layer by photoelectric ionisation impossible, therefore, unless this layer can be explained wholly by other causes, such as impacts by particles of high velocity, its existence shows that hydrogen cannot occur in our atmosphere in the quantity usually adopted. This result agrees with the conclusions of E. van Everdingen on the refraction of sound waves in the upper atmospheric levels. R. S. R.

952. *Ionisation Equilibrium in a Luminescing Atomic System.* **B. Gerasimovič.** (Zeits. f. Physik, 39. 5–6. pp. 361–376, 1926.)—Gives a theory of the statistical and radiative equilibrium of the system under the influence of an external radiation. It is assumed that the principle of detailed balancing of elementary quantum processes, *i.e.*, passages from one elliptical orbit to another, which is used for a system in thermodynamic equilibrium, can be applied to the present case where such equilibrium does not exist. This principle makes it possible to calculate the ratio between the probabilities of the various passages between the different quantum states. A relation is found between the intensity of the external radiation and the temperature of the system itself. A formula is obtained for ionisation equilibrium which, in the limiting case of thermodynamical equilibrium, is identical with that of Saha. The problem is of importance in connection with the conductivity of the upper layers of the earth's atmosphere, the structure of nebulous patches and the cosmic calcium and sodium clouds. The results obtained are applied to the theory of planetary nebulæ with an O-class star as nucleus at the centre illuminating the nebulous gas. The order of magnitude of the "temperature" of the gas is calculated, but this temperature is related to the kinetic energy of the electrons and not to that of the atoms. H. N. A.

LIGHT.

953. *Colour Terminology.* **J. Guild.** (Optical Soc., Trans. 27. 5. pp. 295–300; Disc., 300–306, 1925–1926.)—Gives a description of the questionnaire circulated by the Optical Society of America with the object of arriving at an agreed system of terminology for colour quantities. The voting showed a preference for the following terms, these terms themselves being sufficient to indicate the quantity designated: (*a*) Light, (*b*) greys, (*c*) colours, (*d*) value or brightness, (*e*) saturation, or colour intensity, or value, (*f*) hue. In the *Discussion,* **J. Guild** emphasised the fact that white is as much a colour as any other mixture of visible radiations, and that its special position is entirely a matter of convenience and is due to the fact that in the form daylight it is the most common of all mixtures. In place of "value" he suggested the use of "luminosity-fraction" or "fractional luminosity." **H. E. Ives** urged the adoption of "brightness" and **L. C. Martin** the qualification of this word according to the particular sense in which it was used. J. W. T. W.

954. *Transparency of Ocean Water and Visibility Curve of the Eye.* **E. O. Hulburt.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 553–556, Dec., 1926.)—Measurements of the absorption of ocean water for monochromatic light throughout the visible spectrum are recorded and show that sea water is about as transparent as pure water. When daylight is passed through 40 metres of water the resulting spectral intensity curve is very similar to the visibility curve of the eye both as regards shape and the position of the maximum. Early life on the earth developed in a watery environment with a vaporous atmosphere. This permits the suggestion that the visibility curve of the eye owes its general characteristics to the spectral intensity curve of Palaeozoic daylight. AUTHOR.

955. *An Optical Illusion Depending on Monocular and Binocular Vision.* **H. Opitz.** (Phys. Zeits. 27. pp. 751–754, Nov. 15, 1926. Paper read before the Deut. Naturforscher u. Ärtze, Düsseldorf, 1926.)—Place a rod upright in water and observe it with one eye, then with both eyes. The illusion of shortening is in each case the same. Then slant it away from the spectator, keeping it in the same perpendicular plane. Monocular vision shows no change in its appearance, especially no break at the point of immersion, except that it seems longer, but with binocular vision the rod appears broken at the surface of the water, its end raised and pointing towards the spectator. Mathematically analysed the explanation is that when the eye is penetrated by an astigmatic pencil of rays with two focal lines, of which one, perpendicular to the conducting ray, belongs to the sagittal section, the other, forming an angle with it, belongs to the meridional section, only the latter is perceived by the spectator. E. F.

956. *Colour and Magnetic Properties of Ions.* **G. Joos.** (Ann. d. Physik, 81. pp. 1076–1085, Dec. 11, 1926.)—Spectroscopic, chemical and magnetic evidence is advanced for regarding the carriers of colour and magnetism in the case of the elements forming transition groups (*e.g.*, Sc to Cu), not as simple atomic structures, but as complexes, the formation of which is accompanied by reorganisation of the electron shells. The importance of the magnetic moment as an indication of the structure of the complex is discussed, with special reference to the complex compounds of cobalt. W. S. S.

957. *Coloration of Rock-Salt by Becquerel Rays.* **Maria Bělař.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 5–6. pp. 187–195, 1926.)—The alteration of the absorption of light by rock-salt with the time at six different wave-lengths was measured at regular intervals during a year, the specimens being exposed to β and γ radiations of six different intensities. The relation between the saturation value of the coloration and the intensity of the radiation which produces it was determined. The coloration increases at the commencement more rapidly than corresponds to a simple power of ϵ. At the end of the treatment strongly coloured specimens show no diminution of colour when left for 100 days; there is even an increase in absorption in the long wave-length region of the spectrum. Less strongly coloured ones show a diminution in the short wave-length region and no change for long wave-lengths; very weakly coloured ones show diminution in absorption throughout the spectrum. Observations were made on the change of the colour to violet on heating; this does not take place when the "dose" of Becquerel radiation is small. The effect of sunlight on the coloured salt was further studied. H. N. A.

958. *Theory of the Coloration of Rock-Salt by Becquerel Rays.* **K. Przibram.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 5–6. pp. 197–211, 1926.)—Discusses mathematically the curves obtained by Maria Bělař [see preceding Abstract] and shows that they are best represented by means of an expression the first term of which is due to rapidly variable centres, and the second to others which change more slowly. A factor δ represents a reaction which goes on even in darkness, and another $\epsilon^{-\gamma I}$ the fraction of colour centres which can be discoloured by the Becquerel rays; I is the intensity of these rays. An attempt is made to give a physical explanation of the facts, a colour centre being formed when a quantum splits off an electron from a Cl ion, which electron unites with the neighbouring Na ion, forming a colour centre. Another quantum may split off the electron from the Na atom and discolour it, but this action may not be as rapid as the former. This would account for the two actions, one colouring the salt and the other discolouring it. Probability considerations make it necessary to consider the possibility that the area of the absorbing section of the colour centres can be essentially larger than the section of an atom. H. N. A.

959. *The Causes of Colorations of Salts.* **K. Przibram.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 5–6. pp. 213–226, 1926.)—The fact that the salts of the alkali metals are very suitable for experiments on artificial coloration points to the fact that exchanges of electrons in the orbits of the valence electrons is the cause—that is, that one of the ions gains while the other loses an electron. The colours produced in the different alkali salts are very closely related to the absorption spectra of the free metallic atoms in the form of vapour, but they are modified by the action of the surrounding solid in which the neutral atoms formed as above are embedded. The colours produced in the halogen compounds of these metals are discussed from this point of view, which is confirmed both by a new series of observations by the author using radium radiation and by Bayley's work with X-rays. The stability of the colour produced differs greatly from salt to salt; this depends on the electropositive character of the metal, the affinity of the halogen for electrons and the degree of looseness of the lattice. The author's experiments on the velocity of discoloration in the light and in darkness show specially the diminution of stability with increasing electropositive character, but point also to the action of the two other factors mentioned. H. N. A.

960. *Polariscope for Measurement of Weak Polarisation.* **H. R. v. Traubenberg** and **S. Levy.** (Phys. Zeits. 27. pp. 763–764, Dec. 1, 1926.)—If polarised light passes through a Nicol prism the two emerging rays differ in phase by an amount depending on the thickness of the crystal and the wave-length of the light. Using a quartz wedge, these rays can be made to interfere and form dark bands across the field of view. Details are given of the way in which this principle is applied and its use by the authors to investigate the polarisation of the light from canal rays. R. S. R.

961. *Stereoscopic Telemeter.* (Rev. d'Optique, 5. pp. 462–469, Nov., 1926.)—Description of Gramont-Petit's instrument, constructed by the Société Optique et Précision de Lavallois. The optical organ for measuring the parallax is a deviating prismatic couple which exactly maintains the binocular parallax and which is insensitive to changes of temperature. Adaptation to measurements of height as well as distance. A. D.

962. *Theory of Double Spectrometers.* **P. H. van Cittert.** (Zeits. Instrumentenk. 46. pp. 557–563, Nov., 1926.)—In addition to the monochromatic light transmitted to the second spectrometer, stray light caused by scattering at the prism surfaces, irregular edges of the slit and scratches and air-bubbles in the prism is transmitted. Two patterns of the instrument are considered—one due to Leiss, where the dispersion in the second spectrometer is in the same direction as in the first, and the other due to Lehmann (as well as to the author), where the dispersions are opposed. The purity and intensity of the light transmitted by the two types are investigated. The intensity of transmitted light for the second type is found to be double that for the first. R. S. R.

963. *Polarisation Field of the Nicol Prism.* **J. T. Groosmuller.** (Zeits. Instrumentenk. 46. pp. 563–583, Nov., 1926.)—The basic formulæ for a Nicol prism are first established and then extended for the whole field to give the lines of polarisation in the field. These results are shown graphically for a calcspar Nicol prism. Lippick, and later Bruhat-Hanot, came to the conclusion that the polarisation field is homocentric and that the orthogonal trajectories of the polarisation curves pass through a point, the pole of the polarisation curves. The author concludes that only a very small polarisation field, whose centre lies in the main plane, is homocentric, unless the centre lies in the neighbourhood of the singular point. The field of two prisms is next dealt with, and the equation of the Lipping-Sissingh stripes is established. The rays forming the dark stripes must be polarised at their exit from the first Nicol prism in an azimuth which is uniradial in reference to the rays which are extinguished in the second Nicol prism, whilst for a line of determined intensity the azimuth must form an angle, X, with the uniradial azimuth in the second Nicol. The general conception of the problem thus gives the equation of the X-lines and an indication of the width of the line X = 0 (the Lipping-Sissingh stripes), which increase if the X-lines lie further apart. The equation of the X-lines is found and also the singular points. The movement of the L-S stripes as the prism is rotated and their position for crossed Nicols are investigated to test the earlier theory and assumptions. R. S. R.

964. *Errors of Meridian Telescopes.* **M. Hamy.** (Comptes Rendus, 183. pp. 1238–1241, Dec. 20, 1926.)—The errors of meridian telescopes are considered in connection with the international longitude determinations. Those due to the movements of the micrometer screws are mentioned, but the paper describes principally an experimental determination of the errors arising from irregularities in the bearings and flexure of the instrument. A small illuminated aperture is arranged at the focus of a collimating lens, whose axis approximately coincides with the axis of the telescope bearings. The light is then deflected into the objective of the telescope by three right-angled, totally reflecting prisms rigidly mounted in a plane which rotates about the axis of the bearings and also contains the axis of the telescope. Owing to the properties of the prisms small flexures of their mounting introduce no errors. The method of reducing the observations is outlined. A. Wh.

965. *Germanium XVII. Fused Germanium Dioxide and Some Germanium Glasses.* **L. M. Dennis** and **A. W. Laubengayer.** (J. Phys. Chem. 30. pp. 1510–1526, Nov., 1926.)—Germanium dioxide was fused in a platinum resistor, placed inside a cylindrical crucible of alundum. The fusion took place at about 1400° C., and it was maintained at this temperature for five minutes, and then allowed to cool. The product did not contain more than 0·2 % of impurity. Pieces were selected from this material, ground and polished, and used for determinations of its optical properties. Compared with silicon dioxide, fused germanium dioxide was found to possess a higher refractivity, about twice as great dispersion, about the same transmission except in the ultra-violet, where it is inferior, a much higher density and ten times the thermal expansion. Glasses were made by fusing germanium dioxide with various bases and using the glasses so formed for optical examination. Germanium light flint, barium crown, and boro-crown glasses were prepared by substituting equimolecular amounts of germanium dioxide for silicon dioxide. Compared with the silicate glasses, these germanium glasses possessed a higher refractivity and dispersion, about the same transmission in the visible and infra-red regions, and lower transmission in the ultra-violet. The optical properties of the germanium glasses differ so greatly from those of the corresponding silicate glasses that it is possible to employ them advantageously in the construction of optical systems. F. J. B.

966. *Collimation of Light.* **L. Silberstein.** (Eastman Kodak Co. Research Lab. Comm. No. 265. Optical Soc. America, J. and Rev. Sci.

Inst. 13. pp. 281–289, Sept., 1926.)—Works out how to obtain the best collimation when the lens has a focal length f and an effective aperture $2R$, and the source of light is a plane disc of radius r placed with its centre on, and normally to, the optical axis of the lens. When the disc is placed at the focal position the mean deviation of the refracted rays from axiality is $\Omega = (2r/3f)$ in radians. The minimum Ω is obtained when the disc is placed at $1 \cdot 37f$ from the lens; then $\Omega = 1°31' \cdot 9$ if $r = 0 \cdot 4R$. When the disc is placed at $1 \cdot 4f$ from the lens the image of the disc is the same size as the aperture of the lens; and then $\Omega = 1°32' \cdot 1$. A. D.

967. *Optical Constants of Molybdenite in the Ultra-Violet.* **A. W. Meyer.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 557–560, Nov., 1926.)—The following data were recorded, where n = refractive index, k = absorption index, R = reflectivity:—

Wave-Length.	*k.*	*n.*	*R.*
500	0·341	5·668	52·97
470	0·468	4·999	55·09
450	0·581	4·675	56·75
430	0·657	4·500	58·03
410	0·812	4·002	59·71
390	0·888	3·853	55·04
370	0·963	3·209	52·93
350	0·982	2·640	47·13
330	1·001	2·217	42·10

The increase of refractive index with *increasing* wave-length, to a maximum at 4900 Å.U., is noteworthy. The crystals behave like a metal in the ultra-violet, but as a transparent medium in the visible and especially in the red region of the spectrum. T. M. L.

968. *Optical Constants of Metals in the Visible and Ultra-Violet Regions of the Spectrum.* **G. Pfestorf.** (Ann. d. Physik, 81. pp. 906–928, Dec. 11, 1926.)—Curves are given which show the variation with wave-length (from about 2500 to 5500 Å.U.) of the refractive index n and of the absorption coefficient k in the case of nickel, copper, zinc, gold, steel, silicon and manganese. These curves differ to a remarkable extent from one another—*e.g.*, nickel and copper show a *minimum* absorption at 2900 Å.U. and gold at 3300 Å.U.; but zinc shows a *maximum* at 2600 and 3600 Å.U., and steel at 3100 and 4200 Å.U. In silicon and manganese the value of k decreases progressively as r increases, but a possible minimum is indicated in manganese at 5500 Å.U. T. M. L.

969. *Anomalous Optical Rotation-Dispersion and Magnetic Rotation-Dispersion of Substances the Optical Dispersion of the Rotation of which is Anomalous.* **W. Pfleiderer.** (Zeits. f. Physik, 39. 9. pp. 663–685, 1926.)—Using the apparatus of Krethlow [Abstract 2470 (1925)], at 20° or 18° the author determines the rotation-dispersion (at different concentrations), the absorption and ordinary dispersion of the following solutions:

(1) Camphorquinone in toluene; (2) diphenylmethylenecamphor in benzene, phenylmethylenecamphor in benzene, diphenylcamphormethane in benzene, copper tartrate and caustic soda in water, and the copper and iron salts of oxymethylenecamphor in ethyl alcohol. The first two solutions show anomaly of both the optical and magnetic rotations within the absorption range (Cotton effect of 1896). In curves of the rotation and dispersion plotted against wave-length, the beginning of the anomaly is indicated by sharp inflections. The optical dispersion of (2) is entirely anomalous, which disproves Silberstrom's objection (1916) to Cotton. Both the rotations depend upon the rotatory power of the molecule and the number of molecules; when the molecule weight of the solute is large compared to that of the solvent, the number of dissolved molecules will still be small at a concentration (by weight) of 10 %; for these reasons measurements became difficult in the case of copper tartrate. Measurements of the magnetic rotation of toluene itself, made at twenty-four points in the visible spectrum, confirmed the rule of Becquerel, that the magnetic rotation is proportional to $\lambda dn/d\lambda$ for the range 632 to 450, but not for 450 to 430 $m\mu$. H. B.

970. *Anomalous Dispersion in Electrically Excited Hydrogen, Helium, Neon and Mercury.* **R. Ladenburg.** (Phys. Zeits. 27. pp. 789–790; Disc., 790, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—Classically, anomalous dispersion is to be expected at all the spectral lines of radiating gases. The effect is small but by suitable choice of excitation conditions and using the sensitive method of horizontal interference bands, the author, working with H. Kopfermann and A. Carst, has measured it for many lines of electrically excited He, Ne, Hg and H. Using the Kramers dispersion formula, information as to the transition probabilities and the relative concentrations of the atoms in the various states can be deduced from the measured anomalous dispersion. A number of conclusions are drawn on this basis. W. S. S.

971. *Rotatory Dispersion of Tartaric Acid.* **E. Vellinger.** (Comptes Rendus, 183. pp. 741–743, Nov. 3, 1926.)—Experiment shows that in solutions of dextrose tartaric acid two fundamental forms are present; one dextrose form has the molecular structure of the tartrate, and the lævulose has a structure, still undetermined, corresponding to that of the molecule in a crystal of tartaric acid. [See Abstract 1630 (1925) and next Abstract.] G. E. A.

972. *Rotatory Power of Tartaric Acid.* **L. Longchambon.** (Comptes Rendus, 183. pp. 958–960, Nov. 22, 1926.)—Figures are given to show that the rotatory power and dispersion of tartaric acid increase with dilution at a given temperature and also increase with fall of temperature for a given initial concentration. The results indicate a high rotatory power for the α-acid and locate its dispersion between 2 and 2·15. [See Abstract 1441 (1924) and preceding Abstract.] G. E. A.

973. *Theory of Diffraction by Black Screens.* **F. Kottler.** (Ann. d. Physik, 81. 8. pp. 869–876, Nov. 27, 1926.)—A reply to A. Rubinowicz. [See Abstract 662 (1927).] J. W. T. W.

974. *Dispersion of Atomic Hydrogen. Part I. A Measure.* **R. M. Langer.** (Nat. Acad. Sci., Proc. 12. pp. 639–644, Nov., 1926.)—The apparatus used consists essentially of two identical tubes, filled with hydrogen to the same pressure and placed in the arms of an interferometer. A powerful discharge is passed through the one tube and the fringes focussed on the slit of a spectroscope or a very fast spectrograph. A shift of the fringes is looked for or a series of exposures taken with the discharge alternately off and on. The procedure was repeated for a range of pressures from 0 to 25 mm. with all varieties of conditions of discharge, purity of hydrogen, etc. The shift of the fringes at any wave-length, together with a knowledge of the concentration of atomic hydrogen and the index of refraction of molecular hydrogen, serves to determine the dispersion of atomic hydrogen. Further details of the precautions taken and difficulties encountered are to be given in the *Physical Review*. The experiment is being repeated under conditions having the great advantage of practically complete dissociation into atomic hydrogen. The theory of the method is examined and applied to the results obtained. For atomic hydrogen the index of refraction is found to be 1·000068 for $\lambda = 6000$ Å. R. S. R.

975. *Dispersion of Atomic Hydrogen. Part II. A Calculation.* **R. M. Langer.** (Nat. Acad. Sci., Proc. 12. pp. 644–648, Nov., 1926.)—The author attempts to adjust dispersion formulæ to give the proper frequencies for anomalous dispersion but the value obtained for the refractive index of atomic hydrogen is much too large. If further experiments now in progress verify this violent disagreement, the author considers it will strike through the Kramers dispersion theory at the very foundation of the matrix mechanics, *viz.*, the "correspondence principle," or else, since in this case the original work of Ladenburg leads to the expression derived by Kramers in his development of that work, there may be something wrong with our notion as to the nature of the phenomena of dispersion. R. S. R.

976. *Molecular Scattering of Light at the Critical State.* **L. S. Ornstein** and **F. Zernike.** (Phys. Zeits. 27. pp. 761–763, Dec. 1, 1926.)—The authors criticise in several particulars the work of Kar on this subject [see Abstract 2342 (1926)]. It is asserted that in Kar's new calculation of light scattering, the formula for density changes and, similarly, that given by Smoluchowski are obtained by false approximations, and thus they contradict the accepted independence of the volume element. Further, the optical formula in the neighbourhood of the critical point is said to be untrue. Finally, the authors deduce the equations afresh. R. S. R.

977. *Scattering of Light by Individual Particles in Smokes.* **H. S. Patterson** and **R. Whytlaw-Gray.** (Roy. Soc., Proc. 113. pp. 312–322, Dec. 1, 1926.)—Smoke particles whose dimensions are comparable with the wave-length of light do not scatter light according to Rayleigh's law, and as they are not homogeneous their refractive index is difficult to estimate. The law of scattering is thus found by direct measurement of the radius of the particle, and the intensity of the scattered light, for particles of different sizes. With but slight modifications the radius is found by the method given earlier [see Abstract 849 (1927)]. The scattering is found by using an illuminated artificial particle in the field of view and altering its intensity by means of a neutral wedge to obtain a match. Substances forming chains are avoided and the clouds chiefly studied, MgO, Ag, $HgCl_2$ and Hg, consist of approximately spherical aggregates of smaller particles. The results obtained are not in agreement with Rayleigh's law or with Mie's calculations. The effect of the packing of the particles in each aggregate is considered and the relative sizes of particles in the large and small aggregates. The authors did not find it possible to obtain accurate observations of the law of scattering with transparent liquid spheres. R. S. R.

978. *The Stationary Value of Axially Symmetric Functions. Part I.* **T. Smith.** (Optical Soc., Trans. 27. 5. pp. 307–310, 1925–1926).—The formula for the stationary value of a function previously published [see Abstract 710 (1926)] is now put into a form which shortens the calculations involved in applying it to functions which possess special kinds of symmetry, such as that corresponding to symmetry about an axis.
H. H. Ho.

979. *Photophoresis of Colloidal Particles in Aqueous Solutions.* **W. W. Barkas.** (Phil. Mag. 2. pp. 1019–1026, Nov., 1926.)—Aqueous colloidal solutions of copper, gold, silver and gamboge settling out of suspension were illuminated by an incandescent lamp of 100 c.p., the heat rays being filtered out in a large glass water tank. The cloud moves towards the light side of the cell, the particles being light negative according to Ehrenhaft's convention. Reproductions of photographs show the form of the originally horizontal surface of separation between the cloud and the clear liquid above, this curves downwards from a level a little higher than the original one on the side of the rectangular cell through which the light enters towards the opposite bottom corner; the boundary becomes much more sharply defined. The calculated velocities of the particles are greater in most cases than those measured by Ehrenhaft in gases in an intense beam of light. The results with X-rays were similar to the above. The change in size of illuminated gold particles was measured. H. N. A.

980. *Sensitisation of Photographic Plates.* **W. Leszynski.** (Zeits. Wiss. Phot. 24. pp. 261–275, Oct., 1926.)—Absolute measures have been obtained for the sensitivity to blue, green, and red light on an unsensitised emulsion and on one sensitised for green and for red light. The primary separated silver from an erythrosin-sensitised emulsion exposed to green light, determined by titration, is related to the corresponding number of quanta. The results show that the distribution of the primary separated silver between the surface and the interior of the grains is the same for blue as for green illumination; this conclusion may be confirmed by means of independent photographic experiments. The number of silver atoms resulting from exposure to green light is many times (at least twenty times with erythrosin) the number of dyestuff molecules effecting the sensitisation. As regards sensitisation by erythrosin, it is considered that the dyestuff is adsorbed at the surface of the silver bromide grain and is responsible for the primary light absorption which effects transfer of an electron from a bromine ion to a silver ion. The presence of silver nuclei in the interior of the grain is explained by assuming that a liberated electron is able to migrate to a silver ion some way off. T. H. P.

981. *Herschel Effect.* **W. Leszynski.** (Zeits. Wiss. Phot. 24. pp. 275–291, Oct., 1926.)—Exposure to ultra-red light results in diminution of the blackening of a photographic plate caused by ordinary light, X-rays, α-rays, or hydrogen peroxide. This diminution is observable with development either before or after fixation, but is not detectable with the direct blackening of silver bromide emulsions. The extent of the diminution is independent of the wave-length of the light used, and for equal values of the product of (intensity) × (exposure) is independent of the intensity of the ultra-red illumination, but depends on the intensity of the preliminary exposure; blackening produced by light of extremely feeble intensities cannot be modified in this way. The sensitiveness of the plate for the ultra-red light diminishes with the duration of the action of this light. A plate already containing a latent image remains uninfluenced in its sensitiveness towards light by previous exposure to ultra-red light. On the other hand, a plate with no latent image shows slight diminution of the sensitiveness when previously exposed to ultra-red light. Various observations render doubtful the interpretation of the Herschel effect by the oxidation hypothesis, and a working hypothesis is suggested which regards this effect as a dispersion process with the quantity of silver unchanged. The constancy of the amount of silver has not yet, however, been proved. T. H. P.

982. *Ripening Process.* **Lüppo-Cramer.** (Zeits. Wiss. Phot. 24. pp. 291–298, Oct., 1926.)—The difference in the mode of action of different bromides during emulsification is to be attributed, principally at any rate, to the varying solubilities of silver bromide in the different bromide solutions. The nature of the silver salt is also of importance in this connection, as was found in Germany during the war, when dry plates were made largely by means of silver sulphate; in the case of the more concentrated emulsions, the sulphate led to coagulation of the gelatine. According to Price [see Abstract 1864 (1925)] the silver bromide of photographic emulsions always contains included bromides, the amount of which determine the sensitiveness; since the combination radius of potassium differs more than that of sodium from that of silver, the sensitising action of potassium bromide should exceed that of sodium bromide. The author shows, however, that these results are due to the use of imperfectly dry salts. The theoretical interpretations of Price are also criticised, and the work of Renwick, Sease and Baldsiefen is referred to with approval. [See Abstract 1809 (1926).] T. H. P.

983. *Instrument for Measuring the Blackening of Photographic Paper.* **C. Winther** and **E. H. Mynster.** (Zeits. Wiss. Phot. 24. pp. 298–304, Oct., 1926.)—A description of an instrument in which the blackening to be measured is compared with that of a Goldberg wedge. T. H. P.

984. *Registering Sensitometer.* (Rev. d'Optique, 5. pp. 470–475, Nov., 1926.)—Description of instrument for recording the characteristic curve made by the Établissements Filmograph. The curve is traced directly off the blackening. A. D.

985. *Light and Silver Halogenides.* **J. Eggert.** (Zeits. Elektrochem. 32. pp. 491–499; Disc., 499–501, Oct., 1926.)—A report of a series of investigations from the point of view of quanta of energy taken in and emitted on the production of the latent image and blackening. The discussion becomes polemical. A. D.

986. *Time and Intensity in Photographic Exposure.* **L. A. Jones** and **V. C. Hall.** (Eastman Kodak Research Lab. Comm. No. 266. Optical Soc. America, J. 13. pp. 443–463, Oct., 1926.)—Fourth paper [see also Abstract 1812 (1926)]. If the intensity factor I be below a certain threshold value, no extension of exposure-time or of development-time will make all the silver-halide grains developable; this limit is for Eastman slow lantern plates 316 metre-candles, for Eastman commercial film 5 m.c., for Eastman portrait film 0·079 m.c. There is no evidence of inert grains; if the intensity be sufficient at least 99 % of the grains can be made developable, but if the intensity fall short an increasing percentage of the grains become effectively inert. γ_∞ and D_∞ depend greatly upon I; and accordingly the form of the characteristic curve obtained upon complete development depends on I. It may reasonably be concluded that the smaller grains have a higher threshold intensity than the larger; at low intensities they will escape development altogether. The intensity factor may be of importance as affecting other characteristics of an emulsion. These experiments are being greatly extended. A. D.

987. *Production of Strong Reductions.* **E. Goldberg.** (Zeits. techn. Physik, 7. 10. pp. 500–505, 1926.)—A new method of producing the strongest photographic reductions is here described. It allows the inscriptions and divisions down to 0·001 mm. line distance. A. E. G.

988. *Effect of Changing Hydrion Concentration during the Washing and Digestion Stages.* **S. O. Rawling** and **J. W. Glassett.** (British Phot. Research Assoc. Lab. Comm. No. 57. Phot. J. 66. pp. 495–504, Nov., 1926.)—The properties of an emulsion depend on the precise detail employed in each stage in its preparation, and experience proves that great differences in photographic properties may be caused by apparently minute differences in the methods and substances employed. The present paper describes the first part of an investigation of such a case. With different examples of gelatine having widely different photographic properties, and with emulsions precipitated in presence of ammonia as well as in its absence, the photographic speed obtained after digestion is higher or lower according as to whether the emulsions are digested at a lower or higher hydrion concentration. On the other hand, fog is usually independent of the pH value maintained during digestion. The range of the pH values studied extended from 5 to 9. The change in photographic speed thus produced is not altogether a question of the rate at which sensitivity changes during digestion, because with any one emulsion on prolonged digestion the speed actually reaches a steady value, which is maintained for a time and is different for each different pH value employed. The grain size and appearance seem to be unaltered by changes in the hydrion concentration of digestion. In most cases, when a sufficiently long period of digestion is allowed, the development velocities and shapes of characteristic curve of the emulsions are independent of the changes in hydrion concentration during digestion. The work is being continued. A. E. G.

989. *Sensitivity of Photographic Emulsions in Relation to Quantum Energy in Exposure.* **S. E. Sheppard** and **A. P. H. Trivelli.** (Eastman Kodak Co. Research Lab. Comm. No. 284. Phot. J. 66. pp. 505–513, Nov., 1926.)—A number of recent investigations have indicated that sensitivity for development of the grains of silver halide emulsions centres about certain special points on the grain surface. Strong evidence has been advanced by Sheppard that these " sensitivity centres " or sensitising specks consist of silver sulphide. Further, it has been shown that these " sensitivity centres " are not themselves the light-sensitive material, but only enhance the sensitivity of the silver bromide for development. The authors have provisionally suggested that the function of these specks consists only in concentrating the photochemical product, metallic silver, about them, thus reducing the exposure required to build up a nucleus of metallic silver large enough to induce development. It is now shown that sensitising an inert emulsion by formation of silver-sulphide specks, effective for white light, has little effect for X-rays. It is also shown that desensitisation of an ultra-rapid emulsion by chromic acid is slightly greater for red light than for blue light, and almost negligible for X-rays. These results are considered to support the " concentration function " of the sensitivity specks in regard to formation of the latent image. A. E. G.

990. *Tone Reproduction in the " Half-Tone " Photo-Engraving Process.* **H. E. Ives.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 537–552, Nov., 1926.)—This work is the outcome of a study described in a previous paper [see Abstract 1811 (1926)] of the characteristics of electrically transmitted pictures. These pictures may be received in either of two forms, either as pictures of variable density or as pictures of variable-sized structures. Certain of the properties of variable-sized structure pictures which were brought out by that study are shared by the dot structure of the half-tone picture. Consideration of these properties raised certain questions as to the fidelity of tone reproduction in the half-tone process as ordinarily carried through, and the investigation of these questions led to the accumulation of data here used. The results of this study may be summarised in the statement that the practically universal procedure of making a dot negative directly from the object or copy by exposure through a cross-line screen does not yield correct tone values. A procedure is indicated, however, involving additional photographic operations by which a dot picture of correct tone characteristics may be produced. It is to be expected that with an art so far developed and widely practised as that of half-tone negative making the use of a special procedure of this kind may hardly be expected to be adopted generally unless the demand for accurate tone reproduction is very great. It would, however, appear that the procedure is exactly what is called for in order to systematise three-colour half-tone reproduction. A. E. G.

991. *Williamson Aerial Mapping Camera.* (Engineer, 142. p. 522, Nov. 12, and pp. 551–552, Nov. 19, 1926.)—The outstanding features of this camera as compared with previous apparatus for the same purpose are the use of roll films instead of plates and the provision of an automatic control, which, when once set, continues to make exposures at the desired intervals until the spool of film is used up. The machine also

gives a photographic record of all the data necessary for collating the series of photographs to form a continuous map. It is also possible to take what may be described as "snapshots" manually between the intervals of the main series of photographs. The photographs measure 7 in. by 7 in. The length of the film is 65 ft., which is enough for 100 exposures, and it will form a continuous strip map that may cover 100 to 500 miles of country, according to the elevation from which the photographs are taken. The first paper gives a general account of the apparatus; the second deals principally with the special devices of the gear-box and controlling apparatus. Both papers are illustrated.
A. E. G.

992. *Measurement of Extreme Differences in Brightness with the Tube Photometer.* **A. Hnatek.** (Zeits. f. Physik, 39. 12. pp. 927–932, 1926.)—It has been hitherto customary to take the brightnesses shown by the tube photometer as being equal to the squares of the tube diameters. This method involves errors which are imperceptible only within an interval of five orders of magnitude. By applying the accurate formulæ resulting from photometric theory it is, however, possible to establish a relation between tubes of various lengths and thereby to determine directly even the brightness ratio of the sun and full moon. Mainly mathematical.
E. F.

993. *Speed and Time of Excitation and Vision in Relation to the Stereo-Photometer.* **H. Herbst.** (Zeits. Instrumentenk. 46. pp. 583–586, Nov., 1926.)—Observations at twilight indicate that different minima of light intensity are necessary to produce the sensation of various colours. Analogy with the sense of smell after a gas comes in contact with the olfactory nerve shows that for vision the speed S can be connected with the luminosity c in the form $\log S = a + b \cdot \beta^c$, where a, b and β are constants whose magnitudes differ for different wave-lengths. The perception of brightness is a logarithmic function of the intensity of illumination. The application of these considerations to the Pulfrich stereo-photometer and the Lummer flicker photometers is dealt with, and the effect of the Purkinje phenomenon also enters. It is concluded that light concentration and the sensation of brightness are based on different things and are not directly proportional.
R. S. R.

994. *Luminescence and Absorption, especially of Sylvine Treated with Becquerel Rays.* **F. Urbach.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 3–4. pp. 149–185, 1926.)—The author distinguishes between radiation (by Becquerel or Röntgen rays) and illumination (by light, including ultra-violet and infra-red). The experiments on coloration were made with three crystals of sylvine (KCl), faintly yellow owing to the polishing, and hygroscopic. On account of the latter fact the coloration produced by exposure to radium bromide was difficult to reproduce; winter and summer data were not in accord, while with artificial cooling in liquid air a film of moisture settled on the crystals. The light absorption by the coloured salt had its maximum near 550 $\mu\mu$, which agrees with Bayley [Abstract 581 (1925)]. The colour extinction was particularly investigated for this spectral range. About half of the coloration disappeared spontaneously in the dark within a few days; illumination by white light (1000-watt tungsten lamp), passed through various light filters, showed the strongest fading in green light. The luminescence was studied with natural sylvine crystals of different origins and with powdered artificial KCl crystals; the latter gave stronger effects, yet so weak still, with photo cells and Thirring selenium cells, that only qualitative experiments could be made. Sylvine shows radioluminescence and, after exposure to radiation, thermoluminescence and phosphorescence, particularly also an increase of afterglow and of its extinction by light of short wave-length. The strongest luminescence in the light blue was observed when KCl was examined in red light after exposure to radiation. The phenomena are discussed with particular regard to the view of Przibram [*ibid.*, 134, p. 233 (1925); also Abstract 1123 (1925)] and of Gudden and Pohl. Before exposure to radiation atoms which, after radiation, may be able to form centres, are said to be in the centre state 0. By absorption of one quantum of radiation they pass into the state 1; by absorption of a second quantum (of rays or light) they pass into the excited state 2. Transitions are possible from 0 to either 1 or 2, as well as from 1 to 2, or *vice versa*. Most of the phenomena observed by the author and others may be interpreted in various ways. H. B.

995. *The Alkali Halogen Phosphors.* **R. Pohl** and **E. Rupp.** (Ann. d. Physik, 81. pp. 1161–1166, Dec. 11, 1926.)—The large and more or less optically perfect alkaline halide crystals offer better chances of a quantitative study of the relation between phosphorescence and the photoelectric effect [see Abstract 1265 (1924)] than the microcrystalline powders of the sulphide phosphors. The disadvantage of the alkali halides is, however, their weak phosphorescence. The object of this paper is to show the conditions governing the production of efficient alkali halide phosphors. It is necessary to distinguish four different absorption processes: (1) The characteristic absorption of the grating. Pure NaCl is practically transparent down to 186 $\mu\mu$. (2) Colouring of the first kind, produced by short-wave light, fast electrons on heating in Na vapour. The absorption of this coloured salt has been studied by Gyulai [see Abstracts 989 and 2561 (1926)] and shows a broad band between 500–600 $\mu\mu$. (3) Colouring of the second kind, produced by the introduction of foreign atoms by fusion. This produces sharp bands in the ultra-violet. (4) Colouring by ultra-microscopic particles, usually colloidally distributed Na grains.

These differences in colouring and absorption correspond to still greater differences in phosphorescence: (1) Alkali halides show no phosphorescence unless absorption by foreign atoms takes place. (2) With colouring of the first kind goes weak phosphorescence and the usual photoelectric effect for crystal phosphors. (3) With colouring of the second kind goes considerable phosphorescence excited by wave-lengths corresponding to the absorption bands. The relation between absorption and emission has been worked out in detail by Hilsch and Witte. (4) With colloidal colouring occurs occasionally weak phosphorescence. J. E.

996. *Measurements of Thermophosphorescence of Glass produced by Radium Radiation.* **R. E. Nyswander** and **S. C. Lind.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 651–660, Dec., 1926.)—(1) Visible light emitted by the glass when heated to temperatures around 115° to 255° C. was measured with a polarisation photometer, using radium luminous paint as comparison source. The total quantity of light emitted by equal areas of similarly radiated glass of the same thickness was found by integration of the curves to be constant, independent of the temperature or rate of light emission. The rate of decrease of light intensity at constant temperature approximately fits the equation for the second order chemical reaction $dx/dt = k(a - x)^2$. The values of the velocity constant k increase with temperature in accordance with the van't Hoff equation $\log K = C - a/T$. The temperature coefficient is somewhat lower than that characteristic of chemical reaction but higher than for most purely physical reactions. (2) Heat radiation. Measurements made with a Coblentz silver-bismuth thermopile failed to detect any increased heat radiation accompanying the luminescence. AUTHORS.

997. *Absorption of Radiation in the Upper Atmosphere.* **C. Fabry.** (Phys. Soc., Proc. 39. pp. 1–14, Dec., 1926.)—The author reviews the qualitative results obtained by Cornu, Hartley, Miethe and Lehman and the quantitative results of himself and Buisson and of others. Four regions of absorption bands are examined in detail: (1) Hartley band for the region 2300–3100 $\mu\mu$ Using a photographic photometer, the author finds ozone responds in this region to a Hg vapour lamp as if it were metallic in character, the degree of blackening being measured by a microphotometer. The atmospheric absorption was also measured, using a double spectrograph and quartz fittings. The effects of absorption due to ozone, molecular scattering and to fog and dust are examined. For the series of wave-lengths tested the mean thickness for the ozone layer is found to be a little above 3 mm. (2) Huggins band at 3100–3500 $\mu\mu$. A depth of atmosphere three or four times that at the zenith is required for good absorption. (3) Chappuis bands in the visible spectrum—yellow and red. Molecular scattering explains most of the absorption in the visible region, but Cabannes and Dufay stated a residual selective absorption was due to ozone. (4) Infra-red bands 4μ–7μ. Never observed in the solar spectrum and doubtful if the effect was real or negligible. From Cabannes and Dufay's results it is stated that the ozone layer is probably at a height of 50 km, and that it results from a radiation of wave-length less than 1850 $\mu\mu$ acting on oxygen. Daily variations in the ozone layer have been detected, while the absorption of energy in this upper layer by the ozone probably raises its temperature to a level comparable with that of the lower strata in the temperate regions. R. S. R.

998. *Evaluation of Certain Integrals Important in the Theory of Quanta.* **P. S. Epstein.** (Nat. Acad. Sci., Proc. 12. pp. 629–633, Nov., 1926.)—The integral $I = \int_0^\infty r^3\chi\chi' dr$, where the functions χ and χ' are solutions of the Schrödinger equation

$$\frac{d^2\chi}{dr^2} + \frac{2}{r}\frac{d\chi}{dr} + \left(\frac{2\mu E}{K^2} + \frac{2\mu e^2}{K^2 r} - \frac{(k-1)k}{r^2}\right)\chi = 0,$$

corresponding to different values of E and k, needs to be evaluated in determining the intensities of the hydrogen lines and their fine structure components. The labour of the direct computation term by term is almost prohibitive, and a reduction of the integral to a more convenient expression is given in the present note. W. S. S.

999. *Stripped Atoms of the First Long Period.* **R. C. Gibbs** and **H. E. White.** (Nat. Acad. Sci., Proc. 12. pp. 598–601, Oct., 1926.)—This is continuation of previous work [see Abstract 2866 (1926)] in which the first lines of the principal series were shown to obey the irregular doublet law. The first lines of the diffuse series have been located and shown to consist of an inverted doublet with a satellite. The spectra of SeIII, TiIV and VV are considered in connection with term values, tables of which are given. F. S.

1000. *Simple Light Quantum.* **E. T. Whittaker.** (Phil. Mag. 2. pp. 1137–1139, Nov., 1926.)—It is shown that the energy of the light quantum is wholly absorbed by an atom which it encounters, even though that energy was, immediately before the encounter, distributed over a very large region of space, and that this follows as a strict consequence of the strictly classical electromagnetic theory of light. F. J. B.

1001. *Some New Fundamental Vibrations of Crystalline Substances and their Harmonics.* **O. Reinkober.** (Zeits. f. Physik, 39. 5–6. pp. 437–443, 1926.)—Investigates the relation between the wave-lengths of the fundamental vibrations (*Reststrahlen*) and the atomic weights of the kations in various halogen compounds. Curves are given for iodides, bromides, chlorides and fluorides, and the following new determinations of the wave-length have been made for this purpose, using a grating of copper wire of 0·5 mm. diameter and a radiomicrometer to determine the wave-length at the position of maximum reflection from a compressed and polished reflecting plate of the material investigated: rubidium chloride 74 μ, lithium fluoride 17·1 μ. In the latter case several harmonics of this fundamental vibration were observed. The wave-lengths of the absorptions of sylvine in the short wave-length infra-red were redetermined and found to be 3·20 μ and 6·90 μ. H. N. A.

1002. *Transformation of a Line into a Continuous Spectrum by its Passage through an Absorption Solution of a Particular Critical Density.* **S. Ray.** (Phys. Zeits. 27. pp. 627–630, Oct. 15, 1926.)—The author has previously found that all waves are physically similar in a geometrical sense. He now assumes that white light is essentially an ether pulse, and that colour first arises through the lattice or dispersion medium. The latter may be regarded as due to the change in the values of a/λ for the different Fourier components of the white light which deviate from the true values of the ratio in order to provide the same propagation velocity. This change is caused by the more or less complete resonance of the material particles of the medium with the ether vibrations, whereby energy is absorbed from them, changing their amplitude and consequently the velocity of propagation. For the experimental proof of this standpoint sodium light has been used (later a neon tube) and the spectrum photographed by means of a Hilger quartz spectrograph. Changes in the amplitude were produced by passing the light through a rhodamine solution which possesses an absorption band in the D-line region. It was established for different densities of the rhodamine solution that the lines were observed at different places. Full experimental details are included. Under certain circumstances the photographs of the spectral lines were curved, and for this phenomenon the author cannot yet propose an explanation. H. H. Ho.

1003. *Spectra of Atom Systems with Two Electrons.* **W. Heisenberg.** (Zeits. f. Physik, 39. 7–8. pp. 499–518, 1926).—The helium atom and the related ions Li+, Be++, etc., have been exhaustively investigated from the standpoint of the earlier quantum theory, but treatment on the basis of the recent quantum mechanics has not been submitted hitherto. This is now attempted, and as the basis for the quantum mechanics of the problem of several bodies the characteristic resonance phenomena recently described by the author [see Abstract 297 (1927)] have been adopted. Satisfactory representations of the essential characteristics of the spectra of these atomic systems with two electrons have been obtained. The paper is entirely mathematical. H. H. Ho.

1004. *The Reversible Point in Photophoresis.* **S. Ray.** (Phys. Zeits. 27. pp. 680–686, Nov. 1, 1926.)—§ 1 of the paper discusses photophoresis and light pressure, since the discovery of negative photophoresis has thrown doubt on the latter conception. Mattauch's systematic investigation is dealt with at length both in § 2, where particle size, and in § 3, where pressures are considered. Since the reversible point has not yet been discovered, the effect being always positive to negative and not *vice versa*, the author's own views are described in § 4. The conclusion is drawn that negative photophoresis is analogous to the ascent of a hydrogen balloon subjected to the earth's attraction, the actual effect being compounded of the electric force of light in the direction of propagation on the particle and on the medium. § 5 discusses light pressure and pull, from which the photo effect on selenium particles is concluded to be a pull. § 6 deals with a case of so-called evaporation, and § 7 with reversibility by change of pressure. An account is included of the author's own experimental work in support of his theories. H. H. Ho.

1005. *Intensity Ratio of the Principal Series Doublets of the Alkali Metals.* **Hedwig Kohn** and **H. Jakob.** (Phys. Zeits. 27. pp. 819–825, Dec. 15, 1926.)—Previous researches on the intensity ratios of doublets and their connection with the relative numbers of the dispersion electrons corresponding to the two components are reviewed. Experimental determinations of the intensity ratio for the principal series doublet 2 of cæsium and rubidium are described in which Gouy's method of simultaneous measurement of emission intensities and total absorptions is employed. It is established that the intensity ratios for these doublets are greater than 2, the value given by an application of the third intensity rule of Burger and Dorgelo. W. S. S.

1006. *Constitution and Absorption Spectra of the Ferronitrososulphides.* **L. Cambi** and **L. Szego.** (Accad. Lincei, Atti, 4. pp. 491–497, Dec. 5, 1926.)—From a study of the absorption spectra of several of the iron nitroso compounds, several conclusions can be drawn as to their structure. Compounds containing the groups $S.Fe.N_2O_2$, and $S_2O_3.Fe.N_2O_2$ are analogous to $Fe(N_2O_2C_6H_5)_3$ and $Fe(CNS)_3$. The compound $KS_3Fe_4(NO)_7$ contains ferrous iron at great dilutions. A. Wh.

1007. *Spectrum of Fluorine (Fl).* **H. Dingle.** (Roy. Soc., Proc. 113. pp. 323–334, Dec. 1, 1926).—The spectrum was produced by discharge in a tube containing SiF_4. Efforts to obtain the lines of fluorine without those of silicon were unsuccessful, probably due to action on the glass of the tube. Photographs were taken with a 10-ft. concave grating and with an instrument embodying a grating replica on a prism of small angle. Lists of established and doubtful lines are tabulated. The spectrum is analysed and found to contain doublet and quartet systems of terms. The suggested arrangement is shown to be consistent with Carragan's observations of Zeeman effect. Term values are given for each system and an ionisation potential of about 17 volts suggested. The analysis is discussed in relation to the Heisenberg-Hund theory. F. S.

1008. *Wave-Length Formula for Prismatic Spectra.* **A. Kannapell.** (Rev. d'Optique, 5. pp. 421–424, Oct., 1926.)—Using N, the reciprocal of the wave-length, a new formula with four parameters is proposed for the calculation of the wave-lengths in a prismatic spectrum. It is of the form $N = N_0 + (a\delta + b\delta^2)/(\delta - c)$, in which N_0, a, b and c are constants. The formula is compared with those of Cornu and Hartmann, and a better agreement with Rowlands' values is obtained. F. S.

1009. *Magnetic Separation of the Mercury Line* 5770 *into a Nonet of Special Type.* **H. Nagaoka** and **T. Mishima.** (Imp. Acad. Tôkyô, Proc. 2. pp. 479–480, Nov., 1926.)—Nagaoka has previously observed the division of the line 5770 into a nonet of a type not previously described, using micrometric observation with an echelon grating. A photographic record could not be obtained. The authors have now obtained photograms, using the interference spectroscope. The p components form a triplet, the central component being the strongest; the separation is ± 1/12 only; it is possible that the components are due to enhancement of weak satellites. The n components are symmetrically situated about the initial position of the line; their positions and intensities are indicated in a diagram. H. N. A.

1010. *Continuous Spectrum of Mercury.* **H. Volkringer.** (Comptes Rendus, 183. pp. 780–782, Nov. 8, 1926.)—The continuous spectrum of mercury which has been found to extend from the red to the resonance line [see Abstract 2378 (1926)] has been examined and its method of excitation. It appears in a tube with external electrodes at a temperature of 140° C. and reaches maximum brilliancy at 240° C. Its brightness has been compared with that of a black body at 1520° C., and the curve of intensity is found to have a maximum at $0 \cdot 512\ \mu$, which is approximately twice the wave-length of the resonance line. F. S.

1011. *Spark Spectra of Mercury in the Extreme Ultra-Violet.* **G. Déjardin.** (Comptes Rendus, 183. pp. 1340–1342, Dec. 27, 1926.)—Measurements of a large number of lines in the spark spectrum of mercury down to the limit of the Schumann region are submitted. By using various methods of excitation, it is possible to classify the lines into three groups corresponding probably to radiation from the ions Hg^+, Hg^{2+} and Hg^{3+} respectively. A large number of new lines are included. W. S. S.

1012. *Reversal in Vacuum Tube Spectra.* **T. R. Merton.** (Phil. Mag. 2. pp. 975–978, Nov., 1926.)—Reversal of lines in vacuum tubes is well known and several workers have pointed out the bearing upon the use of the neon lines as wave-length standards. Such reversal can easily be explained when light from the capillary traverses a wider tube. The author has observed it perpendicular to a capillary in tubes of the conventional pattern. The D_3 line has thus been observed under very heavy current excitation with an echelon of resolving power of 500,000, the effect being invisible with a Lummer plate of nominal resolving power of 200,000. The effect can be explained on the supposition of a metastable state as the final state in the transition, this state being only destroyed by collision with other atoms. F. S.

1013. *Comparison of the Spectra of Radon with those of Uranium and Thorium.* **H. Nagaoka** and **T. Futagami.** (Imp. Acad. Tôkyô, Proc. 2. pp. 390–394, Oct., 1926. In English.)—The lines of radon found by Rutherford and Royds and other investigators are compared with those found for uranium and thorium preparations. A large number of lines are common to these spectra, particularly in the region of short wavelengths, and there is little doubt that the lines of radon are observable by spark or arc discharge with the metals or compounds of thorium and uranium. Owing to the different conditions of excitation the intensities show no parallelism. [See Abstract 130 (1927).] W. S. S.

1014. *Low-Voltage Vacuum Furnace and the Carbon Line* 4267. **K. L. Wolf.** (Zeits f. Physik, 39. 12. pp. 883–885, 1926.)—A brief description is given of a carbon tube resistance furnace operating on 14 to 20 volts with currents for 450 to 900 amperes at 0·01 to 0·1 mm. pressure. With this furnace the two components of the 4267 Å.U. carbon line have been examined (using a Rowland plane grating) with a considerable separation. The wave-lengths of the two components are given as 4267·261 ± 0·010 Å.U. for the stronger and 4267·031 ± 0·010 Å.U. for the weaker component. A. B. W.

1015. *The Rare Earths as Activators of Luminescence.* **E. L. Nichols** and **H. L. Howes.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 573–587, Nov., 1926.)—Various rare earth salts were put into solid solution in CaO, CaF_2, Al_2O_3, $NaPO_3$, NaF and borax glass. The photo and kathodo luminescence was observed and the spectra mapped. Various cases of the dominance of one activator over others were noted and the conditions studied. The line-like bands in the spectra of the solid solutions containing traces of thulium, europium, terbium and samarium were approximately located and arranged in "sets" having a common and constant frequency interval. The frequency interval was found to be 18 (almost exactly) in the case of europium and 16 for the spectra of thulium, terbium and samarium. The principle of *essential identity*, first established for the spectra of solid solutions containing uranium, was found to apply to the luminescence of these rare earths; *i.e.*, there are one or more sets of positions in the spectrum which are characteristic of a given activator, and, whatever the solvent, all the luminescence bands of substances containing the activator in question are so located that their crests coincide with these positions. Spectra thus related are said to be essentially identical, although the particular positions in the set thus occupied may not be the same for the different spectra. [See Abstract 2087 (1926).] AUTHORS.

1016. *Distribution of Intensity in a Positive Ray Spectral Line Part II.* **M. C. Johnson.** (Phys. Soc., Proc. 39. pp. 26–37; Disc., 37–38, Dec., 1926.)

—The study of optical spectra of positive rays is continued with the type of tube and Merton wedge described previously. The direction of observation is here longitudinal, in order to isolate the Doppler effect in the "moving" spectrum; accordingly a six-prism spectrograph is substituted for the échelon used with a narrower line in Part I [see Abstract 2384 (1926)]. The results are added to those of Stark, Paschen, Wilsar and Krefft on the same spectrum, and the uncertainties in identifying atomic and molecular carriers are analysed. The distribution of velocity among the particles contributing to the "moving" spectrum is compared with the distribution of velocity in positive rays measured by the electromagnetic method and with some investigations of Retschinsky and Döpel. The appearance of the many-lined spectrum of hydrogen in the positive rays and the ratio of intensity of the "moving" and "resting" spectra are also considered. The inverse square law of probability of electron capture and some consequences of the work of Wien and Rüchardt are the most likely controlling factors in the several phenomena. **Author.**

1017. *Magnetic Bending of Spectral Lines.* **W. Wien.** (Ann. d. Physik, 81. pp. 994–998, Dec. 11, 1926.)—In an earlier work [see Abstract 1147 (1923)] it is shown how, by observing with a slitless spectroscope the light emission from canal rays introduced through a narrow slit into a high vacuum and there subjected to an electric field, the lines arising from neutral and charged particles respectively can be differentiated. The present paper describes the use of a magnetic field to obtain the same result. By comparing the electric and magnetic deflections of lines and bands an approximate value of the specific charge e/m of the particles from which they originate is obtainable. Experimental results for canal rays of oxygen and nitrogen are discussed briefly. W. S. S.

1018. *New Quantum Theory and the Zeeman Effect.* **P. S. Epstein.** (Nat. Acad. Sci., Proc. 12. pp. 634–638, Nov., 1926.)—The wave equation derived by the method of Schrödinger and Eckart for the case of a hydrogen atom in a uniform magnetic field is criticised on the grounds that it does not lead to the standing waves required by Schrödinger's theory. The difficulty arises from the fact that the magnetic forces are not conservative. In order to obtain correct results the system giving rise to the magnetic field must be taken into consideration. When this is done the objection mentioned no longer arises. A generalisation of the Schrödinger-Eckart procedure for deriving the wave equation is suggested. In place of the equation $\left[\mathrm{H}\left(ik\frac{\partial}{\partial q}, q\right) - \mathrm{E}\right]\psi = 0$, which applies only when the Hamiltonian H does not involve the time, the equation $\left[\mathrm{H}\left(ik\frac{\partial}{\partial q}, q, t\right) + ik\frac{\partial}{\partial t}\right]\psi' = 0$ is substituted. The latter form leads directly to the correct result in the case of the Zeeman effect. W. S. S.

1019. *Intensity Measurements of Multiplets.* **R. Frerichs.** (Ann. d. Physik, 81. 8. pp. 807–845, Nov. 27, 1926.)—In order to test the extended "summation rule" of Burger and Dorgelo and others for the intensities of multiplets a series of measurements was made of the relative intensities for groups of lines in the Fe, Cr, Mn, Ti and V spectra. A detailed description is given of the photographic spectrophotometric method employed which contains some novel features. The results for all the elements mentioned, save iron, substantially confirm the summation rule. For iron multiplets in some cases considerable deviations were observed. Preliminary measurements of inter-combination lines of mercury and iron exhibited no detectable regularities. W. S. S.

1020. *Light Flashes of Short Duration.* **J. W. Beams.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 597–600, Nov., 1926.)—For studying the order of appearance of spectrum lines and the time between excitation and emission in fluorescence an optical shutter is necessary which opens abruptly, remains open any desired time from 10^{-9} and 10^{-7} seconds and then closes abruptly. This has been realised by the use of two crossed Kerr cells filled with carbon disulphide and placed between crossed Nicols. The electric field is applied to each cell by the passing of the same spark, but the time of relaxation is varied by changing the length of lead wires from the spark to each cell. F. S.

1021. *The Hydrogen Spectrum in the New Quantum Theory.* **C. Eckart.** (Phys. Rev. 28. pp. 927–935, Nov., 1926.)—The Born and Jordan matrices representing the "coordinates" of the hydrogen atom are calculated. The model is that of an electron revolving without rotation about a positive nucleus. The computation is based on a method developed independently by the author and by E. Schrödinger. Half-quantum numbers appear in the formulæ for the matrices. It is stated without proof that they also enter into the formula for the relativistic fine structure. This will necessitate the consideration of a more elaborate model for the hydrogen atom (the rotating electron of Uhlenbeck and Goudsmit). The intensity ratio of the two brighter components of H_α is calculated and found to be 10 : 2·1 in contradiction with the observed 10 : 8. For H_β the calculated ratio is 10 : 3·6, and the observed 10 : 9. The discrepancy is too great to be accounted for by the incompleteness of the model, and points to a difficulty in the Born and Jordan theory. AUTHOR.

1022. *Hydrogen Bands in the Ultra-Violet Lyman Region.* **S. Werner.** (Roy. Soc., Proc. 113. pp. 107–117, Nov. 1, 1926.)—A discharge-tube consisting of a molybdenum box with a heated tungsten wire along the axis was used to investigate the spectra of easily evaporating metals. Very conspicuous bands of hydrogen between 1200 Å. and 1000 Å. were a disturbing impurity. They were photographed in the 2nd order of a 1-m. vacuum grating spectrograph. A marked temperature effect was noticed, lines near the head of bands being comparatively stronger at low temperature. A table of wave-lengths from 1025 Å. to 1232 Å. is given, the lines being divided into twelve groups. The first excitation potential of the hydrogen molecule has been found by several workers to lie between 11·5 and 12 volts, which corresponds to a frequency near the short wave-length limit of these bands, which are consequently assigned to the excited H_2-molecule. F. S.

1023. *Continuous Spectrum of Hydrogen.* **W. H. Crew** and **E. O. Hulburt.** (Phys. Rev. 28. pp. 936–946, Nov., 1926.)—The continuous spectrum of hydrogen is observed to be of similar character, although of differing intensity, in a number of sources, a Wood tube, an ordinary discharge tube, the separate striations of the positive column, the condensed spark in hydrogen at pressures above atmospheric, and in the water spark. It is of appreciable intensity near Hα, rises slowly to a maximum in the near ultra-violet, and descends slowly in intensity from λ300 to 220 μμ. Bohr's idea, which attributes a continuous spectrum near the Balmer lines to an electron plunging from an unquantised energy region to the second orbit, together with Wright's theory that such unquantisation may exist from any given orbit outwards, is given statistical formulation on the assumption that the plunging electrons obey a Maxwellian law of distribution. A formula for the distribution of energy across the continuous spectrum is obtained which involves an unknown probability, a_n, that the atom exists through the *n*th orbit, the region beyond being unquantised. When a_n is evaluated roughly from general physical considerations the formula agrees qualitatively with the continuous spectra observed in the hydrogen stars and the laboratory sources. It is recognised that the theory is a simple type of the more general theory of retardation spectra. **Authors.**

1024. *Structure in the Secondary Hydrogen Spectrum. Part V.* **O. W. Richardson.** (Roy. Soc., Proc. 113. pp. 368–419, Dec. 1, 1926.)—In Part IV [see Abstract 2361 (1926)] it was shown that a number of bands were associated with Fulcher's bands and it now appears that these and other related bands form a set of band systems whose null lines are connected by a Rydberg-Ritz formula. This makes it possible to apportion the effects observed as between electron jumps and vibration jumps, and the present paper deals with the Q branches, which are the most strongly developed and have been investigated most fully. It is shown that all the lines of Fulcher's red bands arise as a result of transitions in which the total quantum number (electron jump) changes from 3 to 2 and the vibrational quantum number is unchanged. H. H. Ho.

1025. *Supplementary Table of Wave-Lengths of New Lines in the Secondary Spectrum of Hydrogen.* **D. B. Deodhar.** (Roy. Soc., Proc. 113. pp. 420–432, Dec. 1, 1926.)—This paper records some 80 new lines not recorded in Merton and Barratt's tables or in the recent data by Tanaka [see Abstract 2704 (1925)], and found on a number of spectrograms of a low-potential and a low-pressure discharge of hydrogen. Impurity lines due to oxygen, nitrogen, carbon, mercury, barium, carbon monoxide and dioxide, ammonia, water vapour, etc., were carefully tested for, but found to be absent. Further measurements with Merton's plates disclosed 450 new lines including the above, and now recorded in the present paper. H. H. Ho.

1026. *Band Spectra of Helium and Hydrogen at Low Temperatures.* **J. C. McLennan, H. G. Smith and C. A. Lea.** (Roy. Soc., Proc. 113. pp. 183–195, Nov. 1, 1926.)—In ordinary bands as the temperature decreases the bands corresponding to large values of (*m*) decrease in intensity, and the point of maximum intensity shifts to a lower value of (*m*). Helium.—The bands described by Curtis were investigated at three temperatures given by immersing the tube in water, liquid air, and liquid hydrogen. For some series the change in (*m*) corresponding to maximum intensity is clearly shown, while in others the first line is the most intense at all temperatures, lowering the temperature merely reduces the relative intensity of higher members. Hydrogen.—This has been done for room-temperatures and for liquid-air temperatures for wave-lengths from 6900 Å to 3850 Å. A. C. M.

1027. *Selections from the Helium Spectrum.* **W. Leo.** (Ann. d. Physik, 81. 8. pp. 757–800, Nov. 27, 1926.)—This paper is devoted to a study of the lines of ionised helium, a fresh examination having been made of the fine structure of the first two members of the Fowler series for helium by means of a large dispersion grating. The line picture is found to be in complete accord with the earlier description of Paschen [see Abstract 48 (1917)]. The spark picture of He 4686 appears to have superposed upon it a helium band, and this is fully discussed, the relative widths of the series and band being calculated from interference assumptions. The most probable carrier for the band spectrum is concluded to be a He_2 molecule. The Curtis data [see Abstracts 1606 (1922) and 2288 (1925)] are confirmed and extended. Further, a band region at λ4140 has been arranged into several regular line series. H. H. Ho.

1028. *Structure of the Second Order Spectrums of Oxygen.* **C. Mihul.** (Comptes Rendus, 183. pp. 876–877, Nov. 15, 1926.) Fowler [see Abstract 1334 (1926)] has shown that in the second order spectrum of oxygen there is a large number of multiplets corresponding to combinations between double and quadruple terms. He has also remarked on a group of combinations of quadruple terms $^4S_0$, $^4P'_0$, ^4D and a term of unknown nature which he has described by the symbol X. In the present investigation the author has found in the second order oxygen spectrum 4 groups of combinations of the same quadruple terms with terms whose internal quantics he describes by their symbols X_1, X_2, Y_1 and Y_2. The various groups of combinations are included in a table. A. B. W.

1029. *Structure of the Third Order Spectrum of Oxygen.* **C. Mihul.** (Comptes Rendus, 183. pp. 1035–1036, Nov. 29, 1926.).—The paper gives tabulated data relative to the various multiplets in the third order oxygen spectrum. A. B. W.

1030. *Limit of Absorption of the K Series by the Element of Atomic Number 75.* **B. Polland.** (Comptes Rendus, 183. pp. 737–738, Nov. 3, 1926.)—The material was a precipitate obtained from $KMnO_4$, and was tested by means of an ionisation spectrometer, Siegbahn's method being used for measuring the short wave-lengths. The mean value 0·1735 Å. was found for the limit of absorption of the K series by element No. 75. For comparison, a solution of osmic acid was tested in a similar manner, and gave a result agreeing with the value already known. [See also Abstract 656 (1926).] G. E. A.

1031. *The Ultra-Violet Spectrum of KNO_3 and its Variation as a Function of pH.* **(Mrs.) E. Siegler-Soru.** (Comptes Rendus, 183. pp. 1038–1040, Nov. 29, 1926.)—The method and instruments of Vlès and Gex [see Abstract 620 (1926)] were employed. Solutions of KNO_3 of constant concentration (10 g. per 1000) were prepared, the *p*H being modified by HCl or NaHO. The centre of the N band was constant in wave-length, but the intensity of absorption varied with *p*H. The curve was sinuous, like those of the substances previously studied by Vlès, and consisted of three portions, a first sinuosity (system A) between *p*H 0·2 and *p*H 2·5;

a second (system B) between pH 2·5 and pH 5·5 and a third (system C), much more spread out, between pH 5·5, and the alkaline extremity of the pH scale. A can be represented pretty correctly by a duplex system with pK 0·3 and 1·8, B by a duplex system with pK 3·9 and 4·3, while C behaves as a simplex system with $pK = 7$. There are thus five constants pK involved, which may be connected with different degrees of hydration of the anion; the number of the constituents thus found coincides with the number of valencies of nitrogen. On the other hand a comparison of the magnitudes of the coefficients pK with those of nitric acid makes it improbable that the acid valence of the anion is directly concerned in these optical transformations. H. N. A.

1032. *The Terms of the Bands of AlH.* **H. Ludloff.** (Zeits. f. Physik, 39. 7–8. pp. 519–527, 1926.)—The relations between their combinations do not make it possible completely to isolate the terms of the bands of AlH; but the author shows how, with the help of the theory of bands, it is possible to arrive at certain definite results. The three end terms $f_i(m)$ differ from one another only by a linear function of m^*, where m^* is $m - E$, E being the electronic impulse parallel to the axis of figure. It is shown that the quantum numbers differ from whole numbers by one-half. The values of b and β are calculated. H. N. A.

1033. *The Infra-Red Absorption Spectrum of Carbonates.* **C. Schaefer, C. Bormuth** and **F. Matossi.** (Zeits. f. Physik, 39. 9. pp. 648–659, 1926.)—Observations were made with magnesite, Iceland spar, dolomite, $FeCO_3$, $BaCO_3$ and $PbCO_3$; $SrCO_3$ has been observed by Rawlins, Taylor and Rideal. The first four crystals are monoaxial, and were cut perpendicular to the axis, the others are biaxial and the direction of cutting is recorded. Schaefer and Thomas have already investigated Iceland spar, and ascribed the fundamental vibrations of the ordinary rays at about 7 and 14 μ to the CO_3 ions; they have called them "inner" vibrations, pointing out that they may be expected to occur in the spectra of many of the carbonates in addition to "outer" vibrations, which depend in part on the metallic ion and vary in the different carbonates. This appears very clearly in the spectral intensity curves obtained by the authors. The short wave-length portion, $\lambda < 9\mu$, is common to all the carbonates, and is due to the inner vibrations of the CO_3 ions; the long wave-length portions differ from one another. In order to explain the minima as due to fundamental vibrations, upper partials or combination vibrations, it is necessary to assume the existence of an "inactive" vibration, which may combine with an active one to give an active combination vibration. Tables are given with the calculated and observed inner vibrations and long wave-length minima of the different crystals. The intensities of the minima agree well with theory in the case of the inner vibrations. It is hoped that the measurements will give an insight into the structure of the CO_3 group, which is more accurate than that which can be obtained by X-ray analysis. H. N. A.

1034. *The Absorption Spectrum of Strontianite in the Short Wave-Length Infra-Red.* **F. J. G. Rawlins, A. M. Taylor** and **E. K. Rideal.** (Zeits. f. Physik, 39. 9. pp. 660–662, 1926.)—Contains a description of the apparatus used, a spectral intensity curve, and a table giving the wave lengths of minimum intensity. H. N. A.

1035. *Arc and Spark Spectra of Iron in the Far Ultra-Violet.* **L.** and **E. Bloch.** (Ann. de Physique, 6. pp. 409–461, Nov.–Dec., 1926.)—A fuller account of work on the spectrum of iron from 2330 Å. to 1860 Å. [see Abstract 1826 (1926)]. A spectrograph with two 60° prisms of quartz, having dispersion of 3 Å. per mm. about 2300 Å. and 1·5 Å. per mm. about 1860 Å., was used. Spark spectra of first and second order (Fe II and Fe III) were distinguished by the length of line. Mitra's values for the copper lines from 2303 Å. to 2149 Å. were used as standards, and for the remaining ranges Eder's values for copper from 2149 Å. to 1976 Å. and Eder's values for silver from 1976 Å. to 1879 Å. A table of wave-lengths for 1125 lines is given, and the lines classified as arc, first order or second order spark. F. S.

1036. *Structure of the Arc Spectrum of Lead.* **H. Gieseler** and **W. Grotrian.** (Zeits. f. Physik, 39. 5–6. pp. 377–390, 1926.)—The terms in the arc spectrum of lead, previously known and also some new ones communicated in this paper, are shown to represent singlet and triplet terms corresponding to the term scheme advanced by F. Hund for the arc spectra of the elements of the fourth vertical series of the periodic table (C, Si, Ge, Sn, Pb). In addition, an account is given of the determination of higher members of the diffuse series for lead found by Thorsen. Certain anomalies are found to exist both in the intensities of the lines and in the term values. W. S. S.

1037. *Absorption Spectrum of Nickel.* **K. Majumdar.** (Zeits. f. Physik, 39. 7–8. pp. 562–571, 1926.)—The nickel spectrum will complete the third horizontal series of elements [see also Abstract 2846 (1924)]. The under-water spark was used as source, and the nickel was vapourised in an electric oven. Tables and a diagrammatic scheme for nickel levels are given. The absorption lines spring from the three deepest levels found by Bechert and Sommer [see Abstract 2702 (1925)]. It is considered that the conclusion of these workers that f' and d' are the ground terms of NiI is not justified, and that further data are required for the ground level. J. E.

1038. *The Arc Spectrum of Copper.* **P. K. Kichlu.** (Zeits. f. Physik, 39. 7–8. pp. 572–587, 1926.)—Various excitation methods and a Hilger E.I. quartz spectrograph is used. A review and discussion of lines obtained so far are given. Here, with heavy current arcs, many new lines are found. The sharp and diffuse doublet series are followed out to the seventh or eighth term, and it is shown that several of the lines found belong to the principal series. The lines belonging to the s_1, d_2 and d_3 ground levels are tabulated. A paper by Beals [see Abstract 2097 (1926)] appeared on this subject after the authors had sent in theirs. J. E.

1039. *Ultra-Red Absorption Spectrum of Didymium in Glasses and Solutions.* **P. Lueg.** (Zeits. f. Physik, 39. 5–6. pp. 391–401, 1926.)—Weidert has investigated the visible spectrum of certain of the rare earths in glasses and solutions, and the present paper records an extension of the work to the ultra-red spectrum. The apparatus used was that of Dreisch [see Abstract 1056 (1925)] fitted with the Wanschaff mirror spectrometer, and using a fluorspar prism of refractive angle 60° 0′ 17″. The absorption spectra of different ground glasses and solutions containing didymium, neodymium and praseodymium chlorides were measured for the wave range 0·7 to 2 μ. The bands obtained for the glasses were also found for the solutions. The paper is well supplied with tables and curves. H. H. Ho.

1040. *Standard Measurements of X-Ray Wave-Lengths.* **M. Siegbahn and E. Hjalmar.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19. No. 24. pp. 1–12, 1926. In German.)—An account of new precision measurements on CuKα with (*a*) a vacuum spectrograph and (*b*) a tube spectrograph. A description of the modified forms of the instruments is given with diagrams. The precision now obtainable in X-ray spectroscopy is comparable with that of optical spectroscopy. This allows, *inter alia*, the effect of neighbouring atoms on the atomic structure to be investigated. J. E.

1041. *Compton Effect and X-Ray Measurement.* **R. Glocker.** (Zeits. techn. Physik, 7. 11. pp. 571–577, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—It appears that taking the Compton effect into account, the work done in ionisation has the same value for short wave-length X-rays as for long ones. In comparing the photographic and ionisation methods, it appears that the ratio of blackening to ionisation current in air is independent of the wave-length, provided only the electron energy is considered in the calculation. It is shown that the blackening of a silver bromide molecule is a similar process to that of ionising a gas. A small thimble-shaped chamber is described in which the ionisation over a very wide spectral region is proportional to the ionisation obtained in an air chamber. By measuring the radiation re-radiated from some water with two similar ionisation chambers covered with different materials, it was shown that the Compton effect could be calculated numerically, and the results fitted in with the Compton formula for the change in wave-length, so that no appeal to a tertiary radiation was necessary. The work showed how necessary it is for the materials in the construction of ionisation chambers to be "standardised." A. C. M.

RADIOACTIVITY.

1042. *Energy Considerations of Radioactive Radiations.* **H. T. Wolff.** (Phys. Zeits. 27. pp. 640–642, Oct. 15, 1926.)—Chadwick [Abstract 366 (1921)] has shown, on the basis of the α-ray scattering measurements of Geiger and Marsden, that in the case of gold Coulomb's law is valid up to a distance of 3×10^{-12} cm. from the centre of the atom. If this is also the case for radioactive bodies, then it explains the high velocity of the α-particles emitted. A. B. W.

1043. *Artificial Disintegration of Elements.* **J. Chadwick.** (Phil. Mag. 2. pp. 1056–1075, Nov., 1926.)—The author refers to the conflicting nature of the results in investigations of the disintegration of elements by collisions with α-particles obtained by workers in Vienna (notably Petterson and Kirsch) and by Sir E. Rutherford and the author. While the former workers find that disintegration with the liberation of H-particles seems to be a common property of all elements, the author and Rutherford find that only the lighter elements can be disintegrated, and among these there are certain striking exceptions. The failure of the author to observe the effects found in Vienna has been attributed by Kirsch and Petterson to the unsatisfactory optical equipment at disposal for the counting of scintillations. The author shows that this explanation is without foundation, and that he can, with his special microscopes, observe the scintillations produced by any H-particles which are likely to be emitted in the disintegration of a nucleus. The optical systems are described and results of efficiency tests of counters have been given, together with observations of scintillations due to H-particles of short range. Experiments have been made to re-examine the elements lithium, berythan, carbon and oxygen, but no evidence of disintegration has been detected. These results confirm the previous experiments carried out at Cambridge, but are in sharp disagreement with those of the Vienna workers. The author is unable to suggest any explanation which will account satisfactorily for these differences. In certain cases it seems possible that the Vienna procedure of picking out the scintillations due to α-particles and those due to H-particles by the difference of brightness has led to error. A. B. W.

1044. *Law of Distribution of the Range of α-Particles from RaC and RaA.* **I. Curie** and **P. Mercier.** (J. de Physique et le Radium, 7. pp. 289–294, Oct., 1926.)—The distribution of the range of α-particles from RaC and RaA in air has been studied by a method described in a previous publication [see Abstract 2530 (1925)] employing a Wilson expansion-chamber method to make the tracks of individual α-particles visible. The ranges of the α-rays are distributed around the most probable value l according to a law of probability of the coefficient and conforming to the theoretical provisions of Bohr and of Flamm. The value of the coefficient $\rho = \frac{\alpha}{l}$, independent of temperature and pressure conditions, is in accordance with theoretical prediction. The most probable value of the range obtained in this investigation does not differ appreciably from the range extrapolated from curves of ionisation. For the α-ray groups from RaC and RaA it has been found that in air at 15° C. and 760 mm. H_g pressure: $\rho_c = 1 \cdot 1 \times 10^{-2}$; $\rho_A = 1 \cdot 25 \times 10^{-2}$; $\alpha_c = 0 \cdot 76$ mm.; $\alpha_A = 0 \cdot 59$ mm. The ratio of the most probable ranges of α-particles from RaC and RaA is $l_c/l_A = 1 \cdot 471$. Excellent reproductions of Wilson α-ray tracks are shown in illustration. A. B. W.

1045. *Long-Range α-Particles Emitted from Actinium $(B + C)$ Active Deposit.* **P. Mercier.** (Comptes Rendus, 183. pp. 962–964, Nov. 22, 1926.)—Using gas absorbers, in preference to screens of solid materials (*e.g.* gold, Al, or mica), the author has redetermined the number and range of long-range α-particles from actinium active deposit. It is found that the range of these particles is 6·47 cm. at 15° C. and 760 mm.—in good agreement with that found by other observers [Marsden and Perkins, Abstract 1429 (1914); Varder and Marsden, Abstract 312 (1915); Bates and Rogers, Abstract 1197 (1924)]. The number of these particles is estimated at 2·8 particles per thousand of the ordinary α-particles of a range of 5·55 cm. A careful examination was made to discover α-particles of still larger range, but without success; the possible number, if any at all, cannot exceed 30 per 10^6 ordinary α-particles. A. B. W.

1046. *Number of Particles in β-Ray Spectra.* **R. W. Gurney.** (Roy. Soc., Proc. 112. pp. 380–390, Sept. 1, 1926.)—The measurements of the absolute number of the β-particles emitted with different velocities in the β-ray spectra have now been extended to the spectra of ThB and Th(C + D). The separate existence of continuous and line spectra is proved by the presence of the continuous spectrum of T*h*(C + D) in the large gap in the line-spectrum between $H\rho$4040 and 10,080. In these spectra, as in the spectra of RaB, C and E, the total number of particles is found to be consistent with the view that they contain the nuclear electrons, of which there must be one from each atom disintegrating. It is suggested that the fact that the energies of the particles in the line spectra of different bodies are roughly co-extensive with the energies of those in the continuous spectra points to a law of β-ray disintegration, namely, that no γ-rays of high energy can be emitted by those radioactive bodies which expel their nuclear electrons with low energies. From the measurements of the number of particles in certain β-ray lines, minimum values here have been deduced for the probability that the gamma-ray quantum is converted into a β-ray instead of escaping from the atom. For the γ-ray of 150,000 volts energy, emitted by ThB, it is found that the coefficient of conversion in the K-level must be at least 1 in 4. For the γ-ray of 40,500 volts emitted by ThD, the coefficient of conversion in the L-level must be more than 1 in 5. A. B. W.

1047. *Ranges of Secondary β-Rays.* **J. M. Nuttall** and **E. J. Williams.** (Phil. Mag. 2. pp. 1109–1116, Nov., 1926.)—The Wilson cloud method has been used to photograph the tracks of secondary β-rays produced by a beam of homogeneous X-rays of known wave-length in the gaseous oxygen, nitrogen, argon and hydrogen. The stereoscopic photographs of the β-ray tracks have been examined and measured, and the ranges of the β-rays at N.T.P. deduced. It is found that for any one gas, the range of the β-ray is proportional to the square of its initial energy (Whiddington's law), the agreement holding over a range of energies from 4800–27,190 volts. It is also found that the range of the β-ray varies as the reciprocal of the atomic number of the gas, for equal atomic concentrations. Both these relations are included in the law expressed by $R = KV^2/N$, K being a constant and having the value $1{\cdot}42 \times 10^{-8}$, when R is the range in the gas at atomic concentration equal to that of a diatomic gas at N.T.P. A. B. W.

1048. *Direction of Emission of Secondary β-Rays.* **H. Fränz.** (Zeits. f. Physik, 39. 2–3. pp. 92–105, 1926. From the Reichsanstalt).—The asymmetry of the secondary β-rays emitted from lead radiated by γ-rays from RaC has been investigated by means of a Geiger "counter," and the frequency (of occurrence) distribution of the electrons liberated from carbon and lead examined in a single direction of emission. The asymmetry in the case of lead was found to be appreciably > 1 (*viz.* 2·1) in contrast with earlier observations by the ionisation method. A. B. W.

1049. *Slow β-Rays from Mesothorium 2.* **D. K. Yovanovitch** and **A. Proca.** (Comptes Rendus, 183. pp. 878–880, Nov. 15, 1926.)—The energy of the β-rays emitted by Mesothorium 2 has so far been determined as low as 38,000 volts. The authors have attempted to complete the data on the side of much lower velocities. The tabulated data now supplied extend down to 2900 volts approximately. A. B. W.

1050. *Absorption of β-Rays by Matter.* **H. Brennen.** (Comptes Rendus, 183. pp. 1342–1344, Dec. 27, 1926.)—It is shown that the results of G. Fournier [see Abstract 2888 (1926)] lead to the formula

$$\frac{\mu}{\rho} = a + b\frac{\sum_{1}^{n} x_i P_{x_i} N_{x_i}}{\sum_{1}^{n} x_i P_{x_i}}$$

for the mass absorption coefficient of a compound $A_{x_1}B_{x_2}\ldots K_{x_n}$, for β-rays, where N_{x_i} and P_{x_i} represent atomic number and atomic weight, and a and b are constants characteristic of the β-rays employed. The author suggests the modified formula

$$\frac{\mu}{\rho} = a + b\frac{\sum_{1}^{n} x_i N_{x_i}^2}{\sum_{1}^{n} x_i N_{x_i}},$$

which agrees equally well with the experimental results, and is preferable because it gives the same absorption to similar compounds containing different isotopes. W. S. S.

1051. *Secondary Radiations Produced by γ-Rays and their Effect on γ-Ray Absorption-Measurements.* **L. H. Clark.** (Phil. Mag. 2. pp. 783–796, Oct., 1926.)—Tuomikoski [see Abstract 1229 (1909)] investigated the absorption of γ-rays in lead and found that, as the thickness of lead was increased from 0·4 to 18 cm., the absorption coefficient decreased from 0·70 to 0·25 cm.$^{-1}$. Recently many observers have studied the scattered radiation emitted from matter radiated by γ-rays, and Owen, Fleming and Fage [see Abstract 2988 (1924)] have shown that it may play an important part in absorption measurements. The present investigation was made with a view to gaining more information about these scattered radiations and their effect upon γ-ray absorption measurements. It is shown that a given filter becomes a more powerful source of scattered radiation the nearer it is placed to the source of primary γ-rays, and consequently appears more transparent in this position.

A. B. W.

1052. *Reply to F. Běhounek's Paper on the Long-Range Radiation of the Atmosphere.* **W. Kolhörster.** (Phys. Zeits. 27. pp. 555–556, Sept. 1, 1926.)—Refers to a paper recently published by Hoffmann [see Abstract 2129 (1926)] in which he states that with an improved apparatus he has obtained a small but distinct, extremely hard radiation, using the lead absorption method. Otis and Millikan could get no results with lead, but Millikan confirmed the existence of the high altitude radiation, using water as the absorber; he found the coefficient of absorption in water to be 1·8 – 3·0 × 10^{-3} cm.$^{-1}$, which is nearly identical with the author's value determined three years previously. Myssowsky and Tuwim give values which do not differ greatly from the above. Refers also to measurements by Millikan and Bowen, Ahmad and Stoner, Hess, Seeliger, Linke and v. Schweidler. [See Abstract 151 (1927).] H. N. A.

HEAT.

1053. *Influence of Working on the Thermal Dilatation Coefficients of Metals.* **W. Jubitz.** (Zeits. techn. Physik, 7. 11. pp. 522–527, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—With metals belonging to the regular crystal system, such as bronze and cast iron, it is found that working of the metal by rolling or hammering produces no change greater than 1 % in the coefficient of thermal dilatation of the metal. With metals such as zinc, cadmium and magnesium a definite influence on the coefficient by working is observed. Beginning with the cast metal an increase of the coefficient is produced by working until a maximum value is reached, and beyond this the coefficient falls with further working. The values obtained lie within the limits found by Grüneisen and Goens for zinc and cadmium for the coefficients in the direction of the main crystal axis and that at right angles to this axis. Annealing of the metals causes a lowering of the coefficients. With antimony and bismuth the measurements have revealed the presence and approximate magnitude of anisotropy which has not previously been observed thermally. J. N. P.

1054. *The Thermal Conductivity of Vitreous Silica, with a Note on Crystalline Quartz.* **G. W. C. Kaye** and **W. F. Higgins.** (Roy. Soc., Proc. 113. pp. 335–350, Dec. 1, 1926.)—Measurements of the thermal conductivity of vitreous silica have been published by Eucken and also by Barratt [see Abstract 316 (1915)]. The results of the present paper agree with neither, except that Barratt's value for the conductivity increment per 1° C. is confirmed. The method employed is the "divided-bar" method of Lodge and C. H. Lees, and results are obtained at temperatures from 60° to 240° C., showing a linear relation of thermal conductivity with temperature. Values (c.g.s. units) range from 0·00330 at 60° C. to 0·00364 at 240° C., with a mean increase of 0·00000185 per 1° C. A few measurements of conductivity of quartz crystal for heat flow parallel to the optic axis give 0·0222 c.g.s. at 68° C. and 0·0186 at 104° C. For heat flow perpendicular to the optic axis the values found are 0·0129 at 70° C. and 0·0116 at 105° C. T. B.

1055. *Conduction of Heat through Powders and its Dependence on the Pressure and Conductivity of the Gaseous Phase.* **J. Aberdeen** and **T. H. Laby.** (Roy. Soc., Proc. 113. pp. 459–477, Dec. 1, 1926.)—The powder was placed between coaxial cylinders, the outer being cooled by water at 0° C. and the inner electrically heated to a temperature about that of the air and of the ends of the cylinder. The result was that the heat flow was radial over the middle portion of the cylinders, where the quantity of heat was measured by observing the current in the heating coil and the potential drop over a short portion l of its length. It was found that the thermal conductivity in air, CO_2 and H_2 at pressures from 1 to 760 mm. of the very light powder silox, can be expressed by the formula $k = \frac{1}{4}k_0 \log_{10} p/n$, where k_0 is the conductivity and p the pressure of the gas in which the powder is immersed, and n is a constant for each gas. At 760 mm. Hg pressure the conductivity k of the powder was $9{\cdot}76 \times 10^{-5}$ with air, $6{\cdot}70 \times 10^{-5}$ with CO_2 and $40{\cdot}5 \times 10^{-5}$ with H_2. With the best vacuum obtainable $k = 0{\cdot}7 \times 10^{-5}$ cal. cm.$^{-1}$ sec.$^{-1}$ deg.$^{-1}$ for silox. Smoluchowski's theory of conduction in powders leads to a formula somewhat similar to that given above, but his apparatus did not enable him to measure the conductivity of a light powder in a vacuum correctly. The advantages of using such a powder in a vacuum as insulation for liquid oxygen vessels are discussed. H. N. A.

1056. *Measurement of Gas Temperatures.* **H. Schmidt.** (Zeits. techn. Physik, 7. 11. pp. 518–521: Disc., 522, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—In employing a thermo-junction pyrometer for the determination of the temperature of a heated gas, the pyrometer does not attain the temperature of the gas on account of the loss of heat by conduction and through the greater radiation from the solid surface. A type of pyrometer suitable for use with gases at temperatures up to 1100° C. is described and illustrated, in which this source of error is obviated. A strip of nichrome alloy is placed in close proximity to the junction and heated by a second electrical circuit. A metal tube directed towards the junction enables gas to be drawn over the junction when an effect is produced on the e.m.f. unless, by the radiation acquired from the adjacent nichrome strip, the junction is at the same temperature as the gas. The current in the heating strip is accordingly adjusted until, on withdrawing gas over the junction, no deviation in the e.m.f. results. For higher temperatures an incandescent filament may be employed and electrically heated until the temperature, as estimated by an optical pyrometer, shows no difference whether the gas is stationary or circulated, indicating equality of temperature between filament and gas. J. N. P.

1057. *Researches at High Temperatures.* **O. Ruff** and **M. Konschak.** (Zeits. Elektrochem. 32. pp. 515–525, Nov., 1926. Paper read before the Deut. Bunsen Gesell., Stuttgart, May, 1926.)—A method was developed and rigorously tested for the measurement of vapour pressures in a closed electric furnace. Experiments with copper and gold were made, and the results showed no important deviation from previous measurements. The vapour pressures of aluminium oxide, silica and silicon were determined in special gas-tight heating vessels. The values obtained for alumina and silicon are probably reliable, but only a minimum value has been determined for silica. The latent heat of vaporisation for alumina and silicon was calculated from the vapour-pressure curves. The dissociation of silicon carbide was studied, and from an investigation of residues it was proved that the vapour contained silicon and silicon carbide. The heat of the reaction $Si_{gas} + C_s = SiC_{solid}$ was calculated by van't Hoff's equation, and found to be 106·6 calories. The heat of the reaction $Si_s + C_s = SiC$ was calculated to be 25 cals. No grounds for the existence of another carbide were found, and the bearing of the investigation on the technical manufacture of carborundum was discussed. F. J. B.

1058. *New Method of Determining the Vapour Pressures of Aqueous Solutions.* **R. Whytlaw-Gray** and **H. Whitaker.** (Leeds Philosoph. and Lit. Soc., Proc. 1. pp. 97–103, Oct., 1926.)—Droplets of the solution of about 1 mm. diameter are suspended from the end of a fine quartz rod attached to a microbalance and surrounded by an absorbent surface of definite vapour pressure, and the loss of weight during evaporation is followed. For pure water the value of ds/dt, where s is the surface at any time t is constant, while for solutions the graph of surface against time gives a curve on account of the change of vapour pressure as the concentration of the droplet increases. From the rate of evaporation the vapour pressure is calculated by an expression employing Langmuir's deductions from the diffusion theory. In a second method, evaporation is allowed to proceed until the vapour pressure of the droplet becomes equal to that of the surrounding solution when the composition of the droplet is calculated from its weight. As standard of comparison use is made of the carefully determined data with oxalic acid and its dihydrate and sucrose solutions. Measurements made with concentrated sulphuric acid solutions give values for the vapour pressure which agree closely with those estimated by Daudt. [See also Abstract 1181 (1926).] J. N. P.

1059. *A Simple New Method for the Estimation of Very Low Temperatures.* **F. Simon.** (Phys. Zeits. 27. pp. 790–792; Disc., 792, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—A method of estimation of low temperatures by absorption of helium in carbon. The resulting variation in pressure is measured in a delicate manometer. The paper discusses the limits of accuracy and the efficiency of the method. S. G. B.

1060. *Further Experiments with Liquid Helium. Preliminary Determinations of its Latent Heat of Vaporisation and Specific Heat.* **L. I. Dana** and **H. K. Onnes.** (K. Akad. Amsterdam, Proc. 29. 8. pp. 1051–1068, 1926. Comm. Nos. 179c and 179d from the Phys. Lab., Leiden.) —These measurements were carried out in a helium cryostat. Full descriptions are given of the construction and manipulation of the apparatus, and the various sources of uncertainty are considered in detail; the latter include heat leaks, condensation of vapour on the walls of the container, variations of hydrostatic pressure on the liquid during evaporation, and (for specific heat) the correction for the energy expended in heating the helium vapour above the liquid. Temperatures and changes of temperature are obtained from the vapour pressures. The latent heat has a maximum of about 5·7 calories near 3° K. and diminishes again at lower temperatures The values are in fair agreement with the results obtained by Verschaffelt and with the values computed from the laws of thermodynamics. The specific heats are believed to be accurate to within about 3 %, and the variation with temperature is approximately linear over the range 2°·5 to 4° K. Within these limits the specific heat varies from 0·6 to 1·0 cal./gm. A. W. L.

1061. *Solid Helium.* **W. H. Keesom.** (K. Akad. Amsterdam, Proc. 29. 9. pp. 1136–1145, 1926. Comm. No. 184b from the Phys. Lab., Leiden.)—The author first gives a *résumé* of attempts by K. Onnes to solidify helium, following which comes a discussion of means to effect solidification at temperatures already reached. A description is then given with full experimental details, data, and diagram of apparatus of the determination of the melting-point curve. This is succeeded by a graphic account of visual observations of the solidification of helium and behaviour of the solid. H. H. Ho

1062. *Electric Precision Apparatus for Determining Boiling-Point Elevation.* **J. N. Pearce** and **Mildred M. Hicks.** (J. Phys. Chem. 30. pp. 1678–1682, Dec., 1926.)—The apparatus of Washburn and Read [see Abstract 1125 (1919)], in which the boiling liquid is kept streaming over the thermometer bulb suspended in the vapour phase, as proposed by Cottrell, is improved by using a thermocouple, specially calibrated for the range in question, instead of the Beckmann thermometer, and by heating the flask electrically. Good results were obtained with solutions of naphthalene in benzene; the resulting figures are not given. H. B.

1063. *Determination of True Specific Heats at High Temperatures.* **H. Klinkhardt.** (Zeits. Elektrochem. 32. pp. 534–535; Disc., 536, Nov., 1926. Paper read before the Deut. Bunsen Gesell., Stuttgart, May, 1926.)—The sources of error in the determination of specific heats by the ordinary calorimetric methods are largely avoided by heating by kathode rays. An apparatus was designed in which the source of the electrons was the oxide of the alkaline earth metals supported by platinum foil, or a tungsten wire treated with thoria. The anode was formed out of the material under investigation, and was made into a short cylinder with polished surfaces. The reflection of the electrons was prevented by the use of a screen. The block of metal under investigation was heated to the desired temperature by an electric heater, which surrounded the whole vessel. The temperature was measured by thermocouples consisting of 0·1-mm. copper-constantan wire. The method can be used up to temperatures of 1000° C. F. J. B.

1064. *Theory of the State of Matter. Part VII. Molecular Volume at the Boiling Point.* **F. Schuster.** (Zeits. Elektrochem. 32. pp. 550–552, Nov., 1926.)—Van Laar ("Die Zustandsgleichung," 1924) showed that the value of the magnitude b of van der Waals' equation for any molecule may be calculated additively from the corresponding values for the constituent atoms. As the author [Abstract 1870 (1926)] found that, for normal organic compounds, $V_s = 0{\cdot}79b_k$, where V_s is the molecular volume at the boiling point, it is possible to obtain the separate atomic contributions to this molecular volume, and hence to calculate the values of V_s for organic compounds. The values thus obtained for aliphatic and aromatic hydrocarbons from van Laar's numbers agree well with the actual values far better than do those derived from the original atomic volumes of Kopp (1855). The ratio of the critical volume to V_s is not a general constant, but mostly diminishes as the critical temperature falls. The increment of V_s increases on ascending a homologous series. T. H. P.

1065. *Six-Place Tables of the Debye Energy and Specific Heat Functions.* **J. A. Beattie.** (J. Math. Phys. Mass. Inst. of Technology, 6. No. 1. pp. 1–33, Nov., 1926.)—Tables to six significant figures are given of Debye energy and specific heat functions for values of x from 0 to 24. x represents the ratio $\frac{\theta}{T}$, where θ is defined as a "characteristic temperature" of the solid in question, and T the absolute temperature at which C_v and U are measured. Formulæ are given for the calculation of x when that quantity is greater than twenty-four. These formulæ are claimed to yield results correct to one unit in the sixth places. The paper concludes with twenty-three pages of tables. S. G. B.

1066. *Latent Heat of Fusion of Several Metals and their Specific Heats at High Temperatures.* **S. Umino.** (Tôhoku Univ., Sci. Reports, 15.

pp. 597–617, Nov., 1926. In English.)—The method of mixtures, as previously used by the author for similar experiments on carbon steel, was again employed. Details are given of the furnace and apparatus used for fusion of the metals under test and the method of their transference in the molten state to the calorimeter. Sn, Pb, Cd, Zn, Sb, Bi, Al, electrolytic silver, Au, electrolytic Cu, cast iron, Co, Ni, Fe and Cr were examined, and the individual results for the melting points, latent heats and specific heats are dealt with in a series of tables and curves.
S. G. B.

1067. *A Thermoscope for Liquid-Air Baths.* **E. Karrer.** (Frank. Inst., J. 202. pp. 809–810, Dec., 1926.)—A special device for observation and control of low-temperature baths. A tube is partially filled with granular charcoal and a gas. This tube is connected to a simple U-tube manometer filled with mercury. The mercury surfaces are displaced according to the amount of the gas held by the charcoal, *i.e.*, dependent upon the temperature of the charcoal. The range of greatest sensitivity can be obtained by careful selection of the gas in contact with the charcoal. Details are given of the use of argon.
S. G. B.

1068. *Further Evidence Concerning the Magnitude of Internal Pressures, especially that of Mercury.* **T. W. Richards.** (Am. Chem. Soc., J. 48. pp. 3063–3080, Dec., 1926.)—The equations previously recorded [see Abstract 2546 (1924)] for internal pressure relations are amplified, and new evidence concerning the magnitude of the internal pressure of monatomic elements is drawn from the change of compressibility and the change of expansibility with increasing pressure. The necessity for imagining very great internal pressures in order to account for the actual values of compressibility and coefficients of expansion of condensed phases is demonstrated. The values of these intrinsic cohesive pressures are given for a number of elements. In the case of several typical elements it is shown that, by a mathematically consistent and simple approximate treatment, it is possible to predict the behaviour of these properties under high pressure within the limit of experimental error.
T. H. P.

1069. *Calculation of the Molecular Heats of Gases from Equilibrium Constants.* **W. G. Shilling.** (Faraday Soc., Trans. 22. pp. 377–400, Nov., 1926.)—Some of the important industrial processes involving gases, for which the temperature coefficients of the molecular heats are doubtful, are investigated. Use is made of the reaction isochore, $\frac{d \log_e K}{dT} = \frac{Q}{RT^2}$, where Q is the heat of reaction and K the equilibrium constant; of Kirchhoff's equation, $\frac{dQ}{dT} = \Sigma C_f - \Sigma C_i = \Sigma C'$, where ΣC_f represents the sum of the molecular heats of the products of the reaction and ΣC_i the sum of the molecular heats of the initial compounds; and of the equation $Q_T = Q_0 + \int \Sigma C' dT$, where Q_T is the heat of reaction at a given absolute temperature T and Q_0 that at the absolute zero. Study of the nitric oxide equilibrium, the dissociation of carbon dioxide, and the ammonia equilibrium on these lines leads to values for the molecular heats of nitrogen, oxygen, nitric oxide, carbon monoxide, carbon dioxide, and ammonia at temperatures up to 3000°, these being in good agreement with the values already given by Shilling and Partington in "The Specific Heats of Gases." T. H. P.

1070. *The Characteristic Equation of Gases.* **K. Shiba.** (Imp. Acad. Tôkyô, Proc. 2. pp. 398–400, Oct., 1926. In English.)—A further note on a previous paper on van der Waals' equation of state. [See also Abstract 1513 (1926).] The author deduces an expression similar to Clausius' equation, but shows that the latter cannot be taken as a corrected form of the former. He also deduces a similarity to Goebel's equation, and finally gets a rough estimate of the law of intermolecular force. S. G. B.

1071. *Methods for Studying Effusion of Gases.* **H. Weide** and **F. R. Bichowsky.** (Am. Chem. Soc., J. 48. pp. 2529–2534, Oct., 1926.)—Starting with the equation for the rate of effusion of a pure gas through a small hole into an evacuated space, *viz.*,

$$N = N_0 PSt/\sqrt{2\pi kmT},$$

where N is the number of molecules passing through the hole of area S (sq. cm.) in t seconds and N_0 is Avogadro's number (for a cubic cm.), the authors have devised special apparatus for the determination of the temperature and molecular weight of gases. The first apparatus consisted of a rate measuring device in series with a capillary tube of small enough bore to get the desired rate of flow, and a tube containing a small hole and surrounded by a furnace. A pressure gauge was used for measuring the pressure in the gas stream. In their later experiments the rates of flow was calculated from the increase in pressure in the system for a given time. Modifications of the apparatus enable experiments on dissociation at relatively low pressures and temperatures to be undertaken and a preliminary determination of the dissociation constant of iodine at 740° C. was made. W. C. S. P.

1072. *The Joule-Thomson Effect for Air.* **N. Eumorfopoulos** and **J. Rai.** (Phil. Mag. 2. pp. 961–975, Nov., 1926.)—An apparatus was made by means of which the Joule-Thomson effect was measured, at ordinary temperature and at 100° C., for dry atmospheric air passed through plugs of alundum. Temperatures were measured by copper-constantan couples and high pressures by a Dewrance gauge. From the observations it is found that the cooling effect in air at 20° C. is given by $0{\cdot}2492\,(P_2 - P_1) - 0{\cdot}00128\,(P_2^2 - P_1^2)$, in degrees Centigrade. P_2 and P_1 are the pressures on opposite sides of the plug in atmospheres. At 100° C. the Joule-Thomson effect is $0{\cdot}1453\,(P_2 - P_1) - 0{\cdot}00095\,(P_2^2 - P_1^2)$. [See also Abstract 1069 (1926).] G. E. A.

1073. *New Gas Formula and Application to Barometric Pressure.* **S. Drzewiecki.** (Comptes Rendus, 183. pp. 775–777, Nov. 8, 1926).—The pressure on a body whose dimensions compare with molecular distances is given by the formula $P = P_0\left(1 \pm \frac{V \cos \alpha}{\Omega}\right)^3$, where V is the velocity of the body, Ω the molecular velocity and $P_0 = 1/3 \,.\, Nm\Omega^2$. This holds for $V \cos \alpha < \Omega$, while for $V \cos \alpha > \Omega$, $P = P_0\,(1 \pm 3V^2 \cos^2 \alpha/\Omega)$. A formula is also given for the variation of barometric pressure with altitude which reduces to Laplace's formula if the first term only be taken. F. S.

1074. *The Ignition of Gases by an Explosion. Part 1. Carbon Monoxide and Hydrogen Mixtures.* **C. Campbell** and **W. Woodhead.** (Chem. Soc., J. pp. 3010–3021, Dec., 1926.)—An apparatus is described by which a flame is photographed as it travels from one explosive gaseous mixture into another. When the igniting and the ignited gases are mixtures of hydrogen and oxygen in different proportions, the flame travels in both mixtures at the normal explosion-wave rates, the velocity in the second mixture becoming adjusted within a few centimeters. When carbon monoxide-oxygen mixtures are ignited by electrolytic gas, the flame velocity falls rapidly to less than half the normal rate and detonation is re-established only after the flame has travelled several metres. A fairly complete drying of the carbon monoxide does not appear to decrease the flame speed below a certain limit although it lengthens the period before detonation. The addition of more than 1 % of hydrogen to the carbon monoxide mixture allows the flame to proceed immediately at its full rate. A flame just previous to the setting up of the explosion wave in these mixtures tends to show marked discontinuities. [See also Abstract 2319 (1923).] J. N. P.

1075. *Utilisation of Liquid Fuels with a High Content of Organic Sulphur Compounds as Anti-Detonant.* **Y. Aitchidjian.** (Comptes Rendus, 183. pp. 975–978, Nov. 22, 1926.)—Bench trials of a lorry engine with an ordinary carburettor show that satisfactory results are obtainable with a mixture containing 50 % of petrol and 50 % of the lighter oils distilling at 200–300° C. (*d* 0·866) from the bituminous limestone of Ragusa. Similar results are given by heavier oils (220–350° C.; *d* 0·888) from the same source, when used with petrol in the proportion 3 : 7. These bituminous oils hence serve as valuable anti-detonants, their property being due to the relatively high carbon content and to the appreciable proportions of organic sulphur compounds present. T. H. P.

1076. *Influence of Foreign Gases on the CO_2 Band 4·27μ.* **M. Wimmer.** (Ann. d. Physik, 81. pp. 1091–1112, Dec. 11, 1926.)—The absorption of CO_2 at 4·27 μ increased when the foreign gases argon, air, nitrogen, hydrogen were mixed separately with it; the absorption was increased by the gases in that order (*i.e.*, hydrogen added produced the greatest absorption). These results were applied to devise a method for the estimation of the partial pressure of CO_2 in a gaseous mixture. The area of the absorption curve gives a measure of the CO_2 content, provided the nature of the mixture and the total pressure is known. The partial pressure of the CO_2 content can be calculated to 2 % accuracy when the partial pressure is between 0·02 mm. and 1 mm. pressure. The usefulness of the method lies in its power of dealing with small pressures. A. C. M.

1077. *A Review of the Literature Relating to the Critical Constants of Various Gases.* **S. F. Pickering.** (Bureau of Standards, Sci. Papers, No. 541. pp. 597–629, 1926.)—This review of the literature on the critical constants of various gases is an attempt to include all the available data on the more common gases and to select what appear to be the best values. A short description of the nature of the phenomena occurring at the critical point and of the usual methods of determining the critical constants is given, after which the measurements on the various gases are critically discussed. In selecting the final value the precautions taken in the preparation and purification of the gas in question, the methods used in making the determinations, and the agreement between the results of different observers have all been given careful consideration. [See also Abstract 1610 (1926).] AUTHOR.

1078. *Vapour Pressures and Thermal Properties of Potassium and Some Alkali Halides.* **E. F. Flock and W. H. Rodebush.** (Am. Chem. Soc., J. 48. pp. 2522–2528, Oct., 1926).—The vapour pressure has been measured of metallic potassium and of the chlorides of sodium, potassium and calcium and of the iodide and bromide of potassium; in the case of the halides, the heat of sublimation, the heat of solution of the gaseous ions and the lattice energy are also calculated, the values affording support for Born's theory of lattice energy. B. W. C.

1079. *The Influence of Centrifugal Force on Rate of Evaporation.* **E. Mack, Jr.** (Am. Chem. Soc., J. 49. pp. 135–142, Jan., 1927).—In this paper experimental evidence is given in support of Langmuir's views [see Abstract 171 (1917)] on the mechanism of evaporation. A small, high-speed centrifuge is described in which solid iodine is permitted to evaporate and diffuse through an air space under the influence of centrifugal force. It is shown that the effect of the latter on the rate of evaporation is very large, and is proportional to the force as long as the absorbent, placed at the end of the diffusion space, absorbs all of the iodine vapour as fast as it arrives. The explanation cannot be found in an effect on the absorbent or in an effect on the diffusion velocity, but probably in the somewhat amorphous structure of the solid iodine surface, which loses small molecular aggregates and loosely-held molecules of iodine under the influence of the centrifugal force field. A reversal of the positions of the iodine and absorbent so that the iodine vapour diffuses against the centrifugal force does not decrease the rate of evaporation but gives the same rate as found when normal diffusion occurs in the centrifuge at rest. H. H. Ho.

1080. *On Certain Partial Differential Equations connected with the Problems of the Equilibrium of Heat.* **E. Picard.** (Comptes Rendus, 183. pp. 709–711, Nov. 3, 1926.)—In a previous paper on the theory of the equilibrium of a closed radiating surface whose arc is given by

$$ds^2 = \mathrm{E}dp^2 + 2\mathrm{F}dp.\,dg + \mathrm{G}dq^2,$$

the differential equation was obtained

$$\Delta u = c(p, q)\sqrt{\mathrm{EG} - \mathrm{F}^2}\,u,$$

where u is the temperature and

$$\Delta u = \frac{\partial}{\partial p}\left(\frac{\mathrm{G}\frac{\partial u}{\partial p} - \mathrm{F}\frac{\partial u}{\partial q}}{\sqrt{\mathrm{EG} - \mathrm{F}^2}}\right) + \frac{\partial}{\partial q}\left(\frac{-\mathrm{F}\frac{\partial u}{\partial p} + \mathrm{E}\frac{\partial u}{\partial q}}{\sqrt{\mathrm{EG} - \mathrm{F}^2}}\right),$$

$c(p, q)$ representing a positive function of the surface. The paper consists of a discussion of a general solution of this equation in certain special cases. W. C. S. P.

1081. *Theory of Radiometer Effects. Part II.* **T. Sexl.** (Ann. d. Physik, 81. 8. pp. 800–806, Nov. 27, 1926.)—This paper extends the author's previous work [see Abstract 2904 (1926)], in which a general radiometer theory was developed from a linear temperature fall in gases. The formula then derived is now applied to the problem of the force effect on a small sphere of defined dimensions immersed in a stationary thermal current. Certain extensions and generalisations are also added to the theory of the absolute manometer. H. H. Ho.

1082. *New Advances in Radiation Research.* **A. Schack.** (Zeits. techn. Physik, 7. 11. pp. 556–563, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—This paper is divided into four sections. In the first a general description of the law of radiation is given and the method explained by which gas radiation may be determined. In the second descriptions of the physical cause of radiation from a luminous hydrocarbon flame and the effect on the radiation of the presence of carbon particles are given. In the third the effect of the ultra-red radiation of carbon dioxide and water vapour on the transport of heat by these gases is discussed with special reference to the case of steam boilers and furnaces (for example, rolling-mill furnaces), and the efficiency of a tube boiler is attributed almost entirely to the radiation from the gases. The difference in construction of boilers, etc., which are to be heated by radiation or by convection is emphasised and the great importance of heat transport by radiation. In the last section the direct measurement of ultra-red gas radiation is briefly discussed. The experiments of Lent and Thomas at Düsseldorf and those of Möller and Schmick on Bunsen flame radiation are referred to. Finally, the effect of carburation on the temperature of the furnace is indicated. T. B.

1083. *On the Equilibrium between Radiation and Matter.* **R. C. Tolman.** (Nat. Acad. Sci., Proc. 12. pp. 670–674, Dec., 1926.)—Stern's expression [see Abstract 1940 (1926)] for the concentration of a perfect gas which would be in equilibrium with the radiation at any given temperature was obtained not only by application of the dependable first and second laws of classical thermodynamics, but also by that of the less certainly formulated third law, or Nernst heat theorem. It is shown in the present paper that merely by applying the first two laws of thermodynamics it is possible to obtain an equation connecting concentration and temperature of the same form as Stern's, but containing a constant which cannot be evaluated from the principles of classical thermodynamics. It is then shown that the introduction of the third law in the form used by Stern leads to his value for the constant. Arguments are presented, however, which indicate that there might be a more correct manner of introducing the third law, which would lead to a very much higher value of this constant. H. H. Ho.

1084. *Thermodynamics of Gaseous Mixtures.* **V. Fischer.** (Zeits. techn. Physik, 7. 11. pp. 527–531, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—A theoretical treatise in which the differential equations of heat content and entropy are deduced per unit mass in a mixture of two gases. From these results the equilibrium conditions for a mixture in which the constituents are in two different states of aggregation or concentration are evolved and defined. The equations so obtained are used for mixtures of nitrogen, argon, oxygen, argon and sulphuric acid and water and the equations evaluated in these cases. S. G. B.

SOUND.

1085. *Sound Changes Analysed by Records. Part II. Voice and Violin.* **H. M. Browning.** (Phil. Mag. 2. pp. 955–961, Nov., 1926.)—In continuation of previous work [see Abstract 568 (1926)], twenty-five records are given of changing notes on the violin and by the human voice, together with records of tuning forks and motions of the detecting diaphragm. The same arrangement was used as before, except that a small arc replaced the pointolite lamp. The records show that when notes follow one another, the change takes place by means of a slur during a measurable time-interval in the case of the voice, and by a jump when one note on the violin is followed by another. G. E. A.

1086. *New Vowel Theories.* **H. Jung.** (Phys. Zeits. 27. pp. 716–723, Nov. 15, 1926.)—A discussion of the relative merits of the Helmholtz-Stumpf and the Jaensch theories. Both theories agree with Jaensch's experimental results for the vowels A, O and U, and doubt is cast upon the results for the vowels E and I. It is claimed that Jaensch's experiments have not supported his own more complex and less complete theory so well as the Helmholtz-Stumpf theory. W. H. Ge.

1087. *Transmission of Sound through Voice Tubes.* **E. A. Eckhardt, V. L. Chrisler, P. P. Quayle,** and **M. J. Evans.** (Bureau of Standards, Technol. Papers, No. 333. pp. 163–193, Washington, 1926.)—This paper gives the results of an investigation made by the Bureau of Standards of the transmission of sound through voice tubes such as are used on board ship. The work was initiated by the Bureau of Construction and Repair of the Navy Department. A good voice tube should transmit speech with as little diminution as possible in intensity and with a minimum of distortion of articulation. Each of these qualities was separately tested, and tables and diagrams of comparative results are given. Tests were made upon straight tubes, curved sweeps, flexible tubes, fittings, elbows, and terminal cones. A brief discussion of sound filters is given, and a note on the absorption in rigid pipes is appended. Authors.

1088. *Velocity of Sound in Liquids.* **A. Cisman.** (J. de Physique et le Radium, 7. pp. 345–352, Nov., 1926.)—The liquids were contained in U-tubes, one end of which was closed by an iron disc, permitting the action of an electro-magnet to generate a wave of rarefaction. The time of passage of the wave was recorded photographically. Jonesco had shown previously that hammer shocks were transmitted in times which gave very high values for the velocity in the free medium. With the above method, the observations, when used in conjunction with Korteweg's formula, gave good values for the velocity in the free medium. This holds for all the tubes and all the liquids, namely, water, alcohol, ether, benzene, toluol, carbon disulphide and carbon tetrachloride. G. E. A.

1089. *Propagation of Sound Waves in a Long Pipe.* **T. Vautier.** (Ann. de Physique, 6. pp. 311–408, Nov.–Dec., 1926.)—A long memoir dealing with experimental researches on the propagation in a long cylindrical pipe (diam. 1 m.) of sound waves generated by sparks of different strength and percussion caps of an uncharged pistol. The sounds were of very short duration and of very weak intensity so that theoretical conditions were approximately realised. When the pressures in the waves were less than 1 mm. of water sensitive membranes were used for detection, and typical optical records are given in four plates. Careful consideration is given to various corrections, and an appendix of some thirty-five pages gives many details and tables of actual observations. The original paper should be consulted. W. H. Ge.

1090. *Problem in Under-Water Acoustics.* **A. S. Eve.** (Frank. Inst., J. 202. pp. 627–635, Nov., 1926.)—The writer raises an old war problem in connection with the production of an efficient baffle-plate for the bi-directional hydrophone. The latter instrument consists essentially of a bronze diaphragm mounted in a massive ring; at the centre of the diaphragm and contained in a watertight cavity is a granular microphone which responds to the vibrations of the diaphragm. When immersed in water the diaphragm exhibits bi-directional properties, showing sound maxima broadside to each face of the diaphragm and minima in the edge-on positions. A baffle-plate, consisting of a hollow disc of xylonite filled with lead shot (a single layer only), when fixed at a particular distance from and parallel to one side of the diaphragm, had the effect of giving the hydrophone a uni-directional property. Certain peculiarities were observed which made it difficult to reproduce these baffles satisfactorily in large numbers. The problem is now reopened, and the author makes tentative suggestions as a solution of the mode of action of the baffle. A. B. W.

1091. *Large Motion of the Nodes of a String and an Air Column.* **S. Ray.** (Phys. Rev. 28. pp. 1321–1326, Dec., 1926.)—From the result that the velocity of a wave cannot be independent of the amplitude of vibration the large motion of nodes of strings discovered by Raman is explained as well as the drift motion of lycopodium dust in Kundt's tube experiment. [See also Abstract 631 (1911).] Author.

1092. *Acoustics of the Stroh Violin.* **R. N. Ghosh.** (Indian J. of Physics, 10. pp. 141–182, Dec., 1926.)—Using the Stroh violin, which consists of simple mechanical systems having easily calculable free periods, the theory of bowed instruments is verified. The resonances belonging to the diaphragm and the horn are easily found experimentally by visual observation of the vibrating string and also by determination of the wolf note pitch. The radiation of the instrument is of the order of $9 \cdot 4 \times 10$ ergs per second at low frequencies and $5 \cdot 2 \times 10^3$ ergs per second at high frequencies, with an abnormally large radiation of $4 \cdot 4 \times 10^3$ at the resonance pitch of the diaphragm. At this resonance pitch the damping coefficient of the string is of the order 3×10^2, at other frequencies about 10. Bowing pressure is about 7 gm. at ordinary frequencies and 50 gm. at resonance. The results are in substantial agreement with theory.

G. A. S.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

1093. *Uniqueness of Solution of Maxwell's Equations.* **A. Rubinowicz.** (Phys. Zeits. 27. pp. 707–710, Nov. 15, 1926.)—The usual proof that given Maxwell's equations and the initial values of the vectors E and H all subsequent values are uniquely determined, fails to give prominence to the fact that owing to the finite velocity of propagation the values of E and H at a given time and place can be affected only by the initial values within a certain finite region determined by the electromagnetic velocity. A uniqueness proof is here given in which explicit account of this fact is taken. W. S. S.

1094. *Simple Exposition of Electromagnetic Relations.* **H. F. Biggs.** (Phil. Mag. 2. pp. 1052–1056, Nov., 1926.)—The author develops a simplified derivation of the circuital theorems on which Maxwell's electromagnetic equations depend. The teacher's point of view has been kept in the forefront, but the method presents points of physical interest. The theory is now based on the fundamental law of force on a charge moving in a magnetic field, *viz.* $F = \frac{1}{c} ev \times H$ dynes A. B. W.

1095. *Use of the Energy-Impulse Tensor for the Representation of an Arbitrary Symmetric Tensor.* **L. Hanni.** (Tôhoku Math., J. 27. pp. 277–292, Nov., 1926.)—The discussion is limited to symmetrical tensors representing propagated longitudinal motions in homogeneous isotropic media. In the case where the continuity equation of hydrodynamics holds for the medium, the symmetrical tensor may always be regarded as energy-impulse tensor. Where the continuity equation is not assumed the symmetrical tensor is to be considered as the sum of an energy-impulse tensor and another tensor of which the diagonal components are equal and the rest vanish. A number of examples corresponding to electromagnetic and gravitational fields are discussed. W. S. S.

1096. *Remarks on J. Mattauch's Paper on the "Existence of Sub-Electrons."* **M. Reiss.** (Zeits. f. Physik, 39. 9. pp. 631–635, 1926.)—Mattauch deduces from the absence of intersections between the curves of his diagrams that all the charges involved are equal [see Abstract 2658 (1926)]. It is here proved that, even with great differences in the charges there will be no intersections in the portion of the diagram concerned unless certain analytical assumptions are made. H. N. A.

1097. *Initial Stages in Current Propagation along a Homogeneous Line.* **L. Casper.** (Archiv f. Elektrot. 17 pp. 510–519, Jan. 6, 1927.)—An application of Heaviside's operational calculus to the solution of this problem. A. H.

1098. *Magnetic Field of a Conductor of Rectangular Cross-Section.* **M. Strütt.** (Archiv f. Elektrot. 17. pp. 533–535, Jan. 6, 1927.)—Using the method of the vector potential, the author obtains the lines of magnetic force surrounding an infinitely long current-carrying conductor of rectangular cross-section. The lines resemble ellipses. A. H.

1099. *Calculation of the Paths of Kathode Rays in Axial Symmetric Electromagnetic Fields.* **H. Busch.** (Ann. d. Physik, 81. pp. 974–993, Dec. 11, 1926.)—In a method for the measurement of e/m suggested by the author [see Abstract 724 (1923)] the electrons of a narrow pencil emanating from a point P with a given velocity, are deflected by means of an axial symmetric electromagnetic field the axis of which coincides with that of the electron pencil. It is here shown that, imposing no conditions on the field save axial symmetry, the electrons of the pencil will be brought to a focus at another axial point Q provided the pencil is sufficiently narrow. For the case of a nearly homogeneous magnetic field, approximations to the actual paths of the electrons are found and the distance between object and image point of the pencil evaluated with an accuracy of some thousandths per cent. W. S. S.

1100. *Electrostatic Theory of Anomalous Liquids.* **J. J. Bikerman.** (Phys. Zeits. 27. pp. 710–711, Nov. 15, 1926.)—Making new assumptions (*viz.*, that the liquid has a finite dielectric constant k, and that that part of the electric field which affects the surface tension is in the liquid and not in the vapour), a theory is developed. The values of d, the thickness of the surface layer, calculated on this basis are $k - 1$ times those previously obtained. The potential difference, v, between vapour and liquid is practically unchanged. The constancy of $\frac{v}{k-1}$ with varying temperature (Coehn's rule) is established. The results show that the usual behaviour of normal liquids accords well with the idea of the existence of a surface field of the magnitude of that calculated for associated substances if only the value of k is small, as is usually the case. G. A. S.

1101. *Evaluation of the Electrostatic Potentials of Circular and Spherical Conductors, and in Particular of Circle and Sphere Lattices.* **H. Walter.** (Zeits. f. Physik, 39. 12. pp. 908–926, and 40. 3–4. pp. 283–298, 1926.)—The method depends on the Schwarz reflection principle. For a two-dimensional system of m circular conductors K_i carrying charges e_i, it is shown that the potential of the charged conductor K_i can be replaced by that of the point charge $+\Sigma e_i$ at its centre and, by reflection of the remaining $(m - I)$ circular conductors in K_i, a series of smaller circular conductors carrying the same charges but with reversed sign. By suitable applications of this principle the system is replaced by a set of point charges and a number of smaller circular conductors. In this way approximations of any order are obtainable. The method is applied to find the potential of an infinite linear array of equal, equidistant and similarly charged circular conductors and of an infinite double-period lattice made up of rows of equal circles charged alternately positive and negative. In the second communication an analogous method is employed for systems of spherical conductors. W. S. S.

1102. *Electrical Charges from Like Solids.* **P. E. Shaw.** (Nature, 118, pp. 659–660, Nov. 6, 1926.)—The author summarises a series of experiments made on a number of substances in tests of tribo-electricity.

He states three general principles: (*a*) really identical surfaces charge one another according to a definite rule; (*b*) friction between initially identical surfaces causes these to become strained, the strain being revealed by the nature of the charges arising and by the fact that heating restores the surface; and (*c*) rough impact between like bodies in general leaves them with unequal charges. It is thought (*a*) and (*c*) may give a solution for the origin of electric sand storms and dust storms. [See also Abstract 2423 (1926).] R. S. R.

1103. *Small Standard Variable Air Condensers of Low Minima.* **D. A. Oliver.** (Journ. Sci. Instruments, 4. pp. 65–71, Dec., 1926.)—Two types of shielded variable air condensers have been investigated in order to determine which would give (1) the smallest absolute minimum capacity with a variation of about 20 $\mu\mu$F.; (2) the largest ratio of maximum to minimum capacity, with a variation of about 60 $\mu\mu$F. The best values actually obtained for the minima in these two cases were 3·5 $\mu\mu$F. and 5·3 $\mu\mu$F. respectively. It was found that flat semi-circular plates were superior to cylindrical segmental ones. The lowest minimum was obtained when the moving system was insulated on the underside of the top bearing. Disconnection and earth-capacity errors have been fully determined, and these indicate that the absolute values of capacity can be relied upon to less than 0·2 $\mu\mu$F. AUTHOR.

1104. *Limits of the State of Ionisation and Conductivity of the Upper Atmosphere by the Hessian Cosmic Radiation.* **H. Benndorf.** (Phys. Zeits. 27. pp. 686–692, Nov. 1, 1926.)—Expressions are developed to determine the number of ions per c.c. and the conductivity at any height in the atmosphere in terms of the measured values at the earth's surface. Consideration is given to the dependence of ionisation, mobility of the ions and the conductivity on the density of the air and also to the effect of temperature changes. Taking a mass absorption coefficient between the limits $2 \cdot 2 \times 10^{-3}$ and $4 \cdot 5 \times 10^{-3}$ cm.^{2}/gm. for the cosmic radiation, the ionisation and conductivity produced by it at different heights are tabulated. Three separate regions are considered: (1) in the lowest the negative electric carriers are the normal ions; (2) in the next they are partly normal ions and partly electrons; and (3) electrons only. The differences existing in these regions are discussed. It is found that the conductivity (for direct current) at a height of 100 km. acquires a value 10^{10} times that at the earth's surface, the air at this height conducting as well as dry earth. At 70–80 km. (Heaviside layer) a rapid increase of conductivity occurs, while the calculated and observed values at 9 km. agree very well. This provides an explanation of the presence of strong ionisation in the air and also of the large values found at night from experiments on the propagation of electric waves. [See also Abstract 1647 (1926).] R. S. R.

1105. *Conductivity of the Atmosphere.* **Rose Stoppel.** (Phys. Zeits. 27. pp. 755–761, Dec. 1, 1926.)—The results are given of a series of experiments carried out at Hamburg and Akureyri (Iceland) during 1924–26. A self-registering Benndorf electrometer was employed which indicated on a chart every two minutes its electrical state. The charge on the conductor was renewed twice each hour and the two-minute readings commenced five minutes after charging. A record over a considerable time was thus available. A daily periodicity for the conductivity of the atmosphere was established with a maximum between 4h. and 6h. according to local time. A yearly period also exists; in the spring the early morning maximum is less marked, and a secondary maximum shows near to midnight. These oscillations of intensity were not attributable to the influence of light or to changes of temperature, humidity, or pressure. The period is unaltered by the appearance of the aurora, but the maximum is less well marked. The author considers a cosmic influence produces this result and that it is responsible for the electrical changes and the consequent variations in plant growth. R. S. R.

1106. *Measuring the Electric Charges of Natural Mists.* **A. Wigand.** (Phys. Zeits. 27. pp. 803–808; Disc., 808, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—That globules of a mist must carry high charges is shown, *e.g.*, by their great stability. The author and J. Wittenbecher measure the charges with the aid of a large condenser, charged to + 480 volts, the lower plate of which, 277 mm. in diameter, is covered with a removable sheet of filter-paper to catch the falling globules. The increase of weight of the paper is determined; the average radius of the globules (fairly constant) is deduced from diffraction observations, H. Köhler [Abstract 117 (1923)], and the number of globules (of the order 10^6) calculated from these data; an accuracy within 5 or 10 % is claimed for these estimates. The apparatus is encased in lead. Most mist clouds carry positive charges up to 1719 e.s.u. per globule in anticyclonic clouds; sometimes positive and negative layers occur together; in one case 2222 negative e.s.u. were observed. There is a relation between these charges and the potential gradient, but it is not clear. In the *Discussion*, **Seeliger** questioned the high values given. H. B.

1107. *Determination of the Atmospheric Potential-Gradient Reduction-Factor at the Watheroo Magnetic Observatory, Western Australia.* **H. F. Johnston.** (Terrest. Magn. 31. pp. 145–152, Dec., 1926. Paper read at a meeting of the Australian Assoc. for Advancement of Science, Perth, Aug., 1926.)—The standard of reference used was the atmospheric potential at a point 1 m. above flat ground, 25 ft. or more from small obstructions, such as grass and low shrubs, and at a distance from other objects exceeding ten times their height. A continuous record of atmospheric potential was obtained using as collector a brass disc, 1 in. in diameter, covered with a small amount of ionium and protected by bakelite. Typical sets of results are given. To reduce the potential-gradient apparatus figures to volts/m. over level ground to the highest accuracy, it was found necessary (1) to have not less than six simultaneous sets of observations for twenty minutes each spaced through the day, (2) for the standardising station to be as close as possible to the observing station, (3) observations to be taken only on cloudless days and with a wind not less than 10 m.p.h., and (4) electrically disturbing objects as far away as possible and the outside of the observing building earthed by a metallic screen. R. S. R.

DISCHARGE AND OSCILLATIONS.

1108. *Alternating Currents in Rarefied Oxygen in the Same Circuit.* **P. J. Kirkby.** (Phil. Mag. 2. pp. 913–944, Nov., 1926.)—The phenomena described in this paper are an extension of the effects of which an account was previously given [see Abstract 953 (1908)] by the author, and is here summarised. In that paper the question is raised whether the electrical discontinuities at about 0·8 mm. were connected with the discontinuity in conforming to Boyle's law in oxygen at the pressure 0·7 mm., described by C. Bohr and confirmed by other physicists, although Rayleigh, with the most careful investigation and with Bohr's result in his mind, entirely failed to discover any such departure from Boyle's law in the neighbourhood of 0·7 mm. The results established in the present paper, however, show that the abrupt changes of current are not discontinuities in the strict sense of the word, but sudden shifts from one to the other of two possible modes of conduction of electricity through the oxygen at certain pressures and with certain orders of current associated with those pressures. Both these modes are regular and continuous with continuity of pressure, but the one is constant and the other is liable to modification by the past treatment of the gas. If these are associated with different molecular states, one of those molecular states, that of the ordinary currents, might conform to Boyle's law consistently, but not necessarily the other.

A. E. G.

1109. *Electric Discharge in Gases, and the Accompanying Radiation.* **A. Dauvillier.** (Phil. Mag. 2. pp. 1046–1052, Nov., 1926.)—In a former paper [see Abstract 356 (1926)] a hypothesis was put forward to explain the sharp kathodic edge of the negative glow. According to this theory differences of pressure should exist in the discharge. The author has proved the existence of the pressure differences by passing a narrow beam of soft X-rays transversely through the discharge, differences of opacity of the gas being an indication of pressure variations. A study has also been made of the radiations for the different parts of the discharge, characterising their quality by filtration through various screens of celluloid or gold-leaf placed by means of a magnetic device in the path of the beam of radiation. The radiation was in general located in the visible parts of the discharge, with the exception of the Crookes' dark space, where it is noteworthy. The positive glow invariably consisted of Schumann radiations, the intensity being proportional to the current and independent of the voltage. The nature of soft X-rays has also been studied, using antikathodes of carbon and of tungsten. The former showed the emission of K-radiation at 295 volts.

A. B. W.

1110. *Spark Potentials.* **M. Toepler.** (Archiv f. Elektrot. 17. pp. 389–412, Dec. 5, 1926.)—Experimental investigations are described of spark potentials with symmetrical arrangements, similar to that previously described [see Abstract 200 (1927)], both for steady potentials and for potential shocks of short duration but with known time characteristics. In the first part a review of the subject is given, and this is illustrated by diagrams and photographs of the characteristic surfaces giving the regions of the different forms of discharge and their limiting potentials and showing how they depend on gap width and current, also the differences for points, spheres and plates. Part II gives the results of new measurements made with the symmetrical arrangement using two points or spheres. In Part III is described experimental work on the sparking potential for points and for spheres up to 15 cm. diameter with shock potentials up to 300 kV. For these results the original paper should be consulted.

A. W.

1111. *Scattering of Kathode Rays.* **B. F. J. Schonland.** (Roy. Soc., Proc. 113. pp. 87–106, Nov. 1, 1926.)—Experiments on the scattering of fast kathode rays are described in which the conditions for the appearance of single scattering are fulfilled. The velocity of the rays was 0·497, that of light and their energy 77,300 volts. The measurements were made by a balance method by which the ratio of the scattered portion to the rest of the beam could be directly determined. The variation of the scattering with the thickness and atomic number of the scattering material and with the energy of the rays was found to be in accordance with the requirements of the theory of single scattering extended to include a relativity correction. From the mode of variation with energy it is concluded that the law of force between a kathode ray and the aluminium nucleus is that of the inverse square, for distances of approach ranging from $1·8 \times 10^{-11}$ to $3·4 \times 10^{-11}$ cm. The atomic numbers of Al (13), Cu (29) and Ag (47) are calculated from the observed scattering and found to be 12·9, 28·8 and 49·2 respectively. A discordant value of 86·5 in the case of gold (79) is explained by an abnormal secondary emission from this element. A. B. W.

1112. *Kathode Scattering in Dependence on Driving Conditions.* **E. Blechschmidt.** (Ann. d. Physik, 81. pp. 999–1042, Dec. 11, 1926.)—This is the second of a series of papers dealing with kathode scattering problems. The following are among the points considered: The dependence on the geometrical data of research arrangements; particular observations within the kathode dark space; the dependence of scattering on temperature; the dependence on the driving conditions; the dependence on the kathode fall; dependence on kathode material and gas. The paper is illustrated diagrammatically and by photographs. [See also Abstract 2165 (1926).] A. E. G.

1113. *Theory of Kathode Scattering.* **A. v. Hippel.** (Ann. d. Physik, 81. pp. 1043–1076, Dec. 11, 1926.)—This is the third part of a series of papers dealing with the kathode scattering problem, and the following are the main points here considered. The mean energy of rebound of the kations; experimental method of ascertaining the velocity of rebound of kations; the connection between kation energy and scattering; total current and intensity of scattering. Spreading of the scattering particles; the case of the high vacuum; the scattering intensity as function of the driving conditions; comparison between theory and experiment; an upper limit for the scattering intensity with given driving conditions; intensity of scattering and kathode material; intensity of scattering and the nature of the gas; secondary appearances with kathode scattering. [See also Abstract 190 (1927).] A. E. G.

1114. *Striated Distribution of the Space Charge.* **B. M. Cassen.** (Phil. Mag. 2. pp. 948–955, Nov., 1926.)—The author shows that striations will, in general, exist in an electric discharge in the statistically steady state, even when the rate of ionisation is constant at all points along it. The case where one ion is much more mobile than that of the opposite sign is treated analytically. An exact solution of the equations, expressing the electric potential as a function of the distance along the discharge, is obtained in terms of elliptic functions. The formula gives an exact expression for the distance between the striations as a function of physical quantities determining the state of the discharge, and a practical form of the formula shows why the distance varies roughly as the inverse square root of the pressure, explains the concavity of the striations near the anode and their proximity in a constricted tube, and depicts the effects of foreign gases. The formula also predicts a separation of the striations with increasing temperature. H. H. Ho.

1115. *Interior Potential of a Moving Bundle of Electrons.* **P. Bricout.** (Comptes Rendus, 183. pp. 1269–1271, Dec. 20, 1926.)—From a theoretical study of the potential conditions obtaining when the luminescence of a gas is excited by electronic impacts produced by an incandescent filament placed between a grid and plate carrying the same potential with respect to the filament, it is concluded that the determination of resonance-potentials by electronic impacts should be made with reserve and only under such conditions that, with the disposition of the electrodes employed, the electronic current is sufficiently feeble to ensure constant potential at different points in the gas under observation. A. B. C. L.

1116. *Ionisation of Atoms by Electron Impact.* **E. O. Lawrence.** (Phys. Rev. 28. pp. 947–961, Nov., 1926.)—The electron beams used in the present experiments are not characterised by great homogeneity in velocities but by sharp upper limits to their velocity distributions. Critical potentials are measured as the differences between two retarding potentials, thereby eliminating errors due to contact electromotive forces. The following critical potentials associated with ionisation of Hg vapour have been observed: 10·40, 10·60, 11·29, 11·70, and 12·06 volts respectively. The first is identified with simple ionisation of the Hg atom, while the ultra-ionisation potentials are regarded as most probably due to simultaneous ionisation and removal of another electron to a higher energy level in the atom. It is also suggested that the new critical potentials may be identified with band spectra data. Analysis of the data indicates very strikingly that each type of inelastic impact involving ionisation has a maximum probability of production when the impacting electron has just enough energy to carry through the process. The law here found governing the probability of ionisation by electrons is identical with the corresponding probability law governing the photoelectric ionisation of cæsium vapour observed by Mohler, Foote and Chenault. This fact has led to the following generalisation. Light quanta and electrons obey the same general laws in processes involving ionisation of atoms and molecules. A. E. G.

1117. *Significance of Certain Critical Potentials of Mercury in Terms of Metastable Atoms and Radiation.* **H. A. Messenger.** (Phys. Rev. 28. pp. 962–975, Nov., 1926.)—The critical potentials of Hg, as found by Franck and Einsporn [see Abstract 126 (1921)] using the modified Lenard method, are studied by a further extension of this method which separated the effects due to metastable atoms and those due to true radiation. Quartz and calcite filters are interposed between the excitation system (hot kathode and grid) and the detecting system ("photoelectric" plate and grid) of a four-electrode tube containing Hg vapour. The critical potential curves taken with and without these filters interposed are compared, the difference in the currents giving a measure of the relative number of metastable atoms produced at each voltage. All the breaks found by Franck and Einsporn except those at 5·76, 6·73 and 8·35 volts are found to be associated with increased production of metastable atoms. The hitherto unexplained breaks found by them at 6·04, 6·30, 7·12, 7·46, and 8·09 volts are found to be due mainly to the formation of metastable atoms. The difference between the photoelectric currents with the quartz and calcite filters interposed give a measure of the radiation lying between $\lambda 1650$ and $\lambda 2200$, that is, of the molecular bands $\lambda 2140$ and $\lambda 1849$. The latter radiation is found to be the cause of the breaks at 6·7 and 8·35 volts. The break at 7·73 volts is interpreted as the combined effect of radiation due to excitation at 7·69 volts and at 7·83 volts. A. E. G.

1118. *The Glow Electric Emission of Electrons with Changing Conditions of the Kathode Material.* **A. Goetz.** (Phys. Zeits. 27. pp. 795–796; Disc., 796, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—By means of a high vacuum oven with pressures of about 10^{-6} mm. the melting temperature of metals is exceeded in cases in which the melting point lies so high that a measurable electron emission is already present while the metal is in the solid condition. It is found that the molten metal exhibits a higher electron emission than the solid at the same temperature. The curve shows that the increase of the emission is brought about by a reduction of the glow-electric work of emission. This causes an unsteady saturation current. A. E. G.

1119. *Some Thermionic Experiments with a New Source of Positive Ions.* **C. H. Kunsman.** (Nat. Acad. Sci., Proc. 12. pp. 659–662, Dec., 1926.)—It has been found already [see Abstract 156 (1926)] that fused mixtures of iron oxide containing about 1 % of an oxide of an alkali or alkaline earth metal furnished a very convenient source of positive ions when used as the hot anode in a vacuum tube. These ions were shown by Barton and Harnwell to be single atoms stripped of one electron and very largely the ions of the introduced alkali or alkaline earth metal. The ease of operation and reproducibility of the thermionic emission has now enabled experimental results (described in the paper) to be obtained which throw considerable light on the mechanism of this emission. In every case where it was possible to measure both ion and electron currents, ϕ_-, the equivalent voltage of the work function for the vaporisation of the latter was found greater than ϕ_+ for the former. It is concluded that on the vaporisation of an element from a surface the vaporisation will be in the form of positive ions providing the ϕ_- of the surface is greater than the potential tending to hold the outer or conduction electron to the atom about to be vaporised. H. H. Ho.

1120. *Gas Ion Mobilities in Ether-Hydrogen Mixtures.* **L. B. Loeb.** (Nat. Acad. Sci., Proc. 12. pp. 617–621, Nov., 1926.)—Mobilities of positive and negative ions in mixtures of hydrogen and ether containing up to 100 % of ether are determined. For negative ions the results conform with those calculated by means of Blanc's formula [see Abstract 508 (1909)]. For positive ions the same is true in the case of mixtures containing more than 30 % of ether. A small trace of ether lowers the mobility appreciably. The results are discussed in terms of the ageing of ions referred to by

Erikson [see Abstracts 594, 763 and 824 (1926)] and the formation of clusters. J. S. G. T.

1121. *Ionic Mobilities in Ammonia-Hydrogen Mixtures and an Anomalous Effect of Ammonia.* **L. B. Loeb.** (Nat. Acad. Sci., Proc. 12. pp. 677–684, Dec., 1926.)—The mobility of positive ions in hydrogen and air is increased by as much as 30 % by the presence of a trace of ammonia in the experimental chamber, whilst that of the negative ion is unaltered. Subsequent addition of ammonia in excess of about 0·1 % reduces the respective mobilities by about the same amount. This result is interpreted on the assumption of the formation of a stable $N^{+}H_4$ ion by association of a molecule of ammonia with a positive hydrogen nucleus. J. S. G. T.

1122. *Probability Formula.* **E. Fermi.** (N. Cimento, 3. pp. 313–318, Nov., 1926.)—If $y_1, y_2, \ldots y_n$ are quantities such that the probability that y_i has a value between y_i and $y_i + dy_i$ is $\phi_i(y_i)$, then K_i^2 is defined as $\int_{-\infty}^{\infty} y_i^2 \phi_i(y_i) dy_i$. It is then shown that the probability that $y_1 < a$; $y_1 + y_2 < a$; $y_1 + y_2 + y_3 < a$; . . . ; $y_1 + y_2 + \ldots + y_n < a$ is given by :—

$$P = \frac{2}{\sqrt{\pi}} \int_{\frac{a}{\sqrt{2\sum_1^n K_i^2}}}^{\infty} e^{-x^2} . dx.$$

A. Wh.

1123. *Photoelectric Emission.* **G. Polvani.** (N. Cimento, 3. pp. 319–333, Nov., 1926.)—The probability that a quantum absorbed in a metal surface will cause the emission of a photoelectron is investigated. The exponential intensity at different depths and the effect of successive atomic encounters is considered, the analysis being based on the probability expression given by Fermi [see preceding Abstract]. The results are compared with experimental data. A. Wh.

Mr. Hall has photostat copy of this.

1124. *Undamped Oscillations in Photoelectric Cells and their Applications.* **B. L. Rosing.** (U.S.S.R. Sci. Techn. Dept. Moscow, No. 147. pp. 7–8, 1926. In German.)—Lately photoelectric cells whose action depends upon the discharge of negative electricity from the surfaces of alkali metals have come into prominence. The currents produced, however, are feeble, and the author points out that the range of employment of the photo cell is much extended if a tension is employed which is higher than the discharge potential, and so a glow of the gas in the photo cell is produced. Thus the efficiency of the photo cell as an energy generator can be increased more than tenfold. Besides a particular phenomenon of undamped oscillations occurs, which may lead to extended practical applications. Thus in photoelectric signalling the signals may be received in the form of acoustic vibrations, and a photometer is possible in which illuminations may be measured by comparison of the pitch of the oscillations produced. The form of the characteristic of the photo cells is extended experimentally. The full characteristic (relation between the applied tension and the current strength) gives the possibility of establishing a theory of the undamped oscillations. A method of signalling depending upon the so-called ballistic discharge of the cell has afforded good practical results up to a distance of 10 km. J. J. S.

1125. *The Self-Tuning Crystal.* **Franziska Seidl.** (Phys. Zeits. 29. pp. 816–819, Dec. 15, 1926. Akad. Wiss. Wien, Ber. 135. 2a. No. 9. pp. 453–464, 1926.)—This is a continuation of experiments previously described by the author [see Abstract 1441 (1926)], and new methods of connecting up oscillating circuit and crystal are described. Further work is in progress. A. E. G.

1126. *Electric Waves and their Propagation.* **E. Rutherford.** (Nature, 118. pp. 809–811, Dec. 4, 1926. Paper read before the Roy. Soc., Nov., 1926.)—A short historical account is given of the development of present-day knowledge of electric waves, their properties, applications and propagation. Reference is also made to various researches having a direct bearing on the propagation of both short and long electric waves. A. W.

1127. *The Propagation of Waves in Wireless Telegraphy.* **A. Sommerfeld.** (Ann. d. Physik, 81. pp. 1135–1153, Dec. 11, 1926.)—The author summarises his previous work on this subject, together with that of Hoerschelmann [see Abstract 1092 (1912)]. He also investigates the dual problem of magnetic horizontal and vertical antennæ, and obtains formulæ for short-distance propagation of surface waves and the directional effect of the latter. The paper is mathematical and cannot usefully be abstracted. E. T. A. R.

1128. *Method of Determining Very High Resistances and Capacities by Means of "Kippschwingungen."* **E. Kurz.** (Archiv f. Elektrot. 17. pp. 413–415, Dec. 15, 1926.)—A method is here described and illustrated diagrammatically for measuring extremely high resistances and capacities with the aid of "Kippschwingungen" in a very simple manner. [See also Abstracts 2179 (1926) and 202 (1927).] A. E. G.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1129. *Influence of Pressure on the Electric Conductivity of Platinum.* **A. Michels and P. Geels.** (K. Akad. Amsterdam, Proc. 29. 8. pp. 1106–1112, 1926.)—The variation with pressure of the resistance of platinum was obtained by comparison of a platinum thermometer subjected to pressures up to 250 atmos. with a similar thermometer at the same temperature but not exposed to pressure. Special precautions were taken in the construction of the thermometers to obtain satisfactory insulation, and to avoid thermal after-effects, uneven tension of different parts of the wires, or strain at the junctions with the leads. For the range 0 – 51·5 kg./cm.^{2} the coefficient of mean fractional decrease of resistance per kg./cm.^{2} is $3 \cdot 68 \times 10^{-6}$ at 15°·57, $3 \cdot 70 \times 10^{-6}$ at 21°·95, and $3 \cdot 80 \times 10^{-6}$ at 34°·75. Over the range 201·5 – 251·5 kg./cm.^{2} the coefficients at these temperatures fall to 1·86, 2·03, and $2 \cdot 20 \times 10^{-6}$ respectively. The chief differences between the values now obtained and the results given by earlier investigators are that the coefficients show a larger variation with pressure and that at the lower pressures they are more variable with temperature; these discrepancies may be attributed to the larger intervals of pressure covered by the earlier measurements. A. W. L.

1130. *Further Study of the Inertia of the Electric Carrier in Copper.* **R. C. Tolman** and **L. M. Mott-Smith.** (Phys. Rev. 28. pp. 794–832, Oct., 1926.)—An account is given of an attempt to measure the ratio of mass to charge of the carrier of the electric current in copper, by a method based on that used originally by Tolman, Karrer and Guernsey [see Abstract 1960 (1923)]. A copper cylinder is oscillated about its axis and the current due to the lag of the electrons in the cylinder detected by the e.m.f. induced in a secondary coil enveloping the cylinder. If the axis of the cylinder coincides with the resultant magnetic field of the earth, this field should produce no disturbing e.m.f. In the present paper, however, a thorough study is made of the effect of the earth's field when parallelism is not attained. The results show that under the conditions worked with, the effect of the earth's field is eliminated. The final value obtained for the e.m.f. set up by the inertia of the electrons is found to have an amplitude 19 % less and a phase lagging 10° behind that predicted on the elementary theory assuming a perfectly rigid conductor with "free" conducting electrons having the same mass as electrons in free space. Possible errors in the experimental work are discussed in detail. W. S. S.

1131. *Apparent Relation between the Rate of Change of the Electrical Resistance at Fusion and the Crystal Lattice of Metallic Elements.* **H. Perlitz.** (Phil. Mag. 2. pp. 1148–1152, Nov., 1926. Paper read before the Naturalists' Soc., Tartu, March, 1926.)—The structure and the electrical resistance undergo an abrupt change when a metallic element is heated to its melting point. Since melting of a metal means a complete collapse of the crystal lattice formed by the atoms of the metallic elements in the solid state, it was thought probable that a relationship exists between the discontinuity of the electrical resistance at fusion and the crystalline lattice of metallic elements. The available data were examined, and out of nineteen elements, twelve elements are in favour of the statement that the rate of change of the electrical resistance at fusion is related to the crystal lattice, and six elements leave the question in doubt, while in one case considerable divergence was found. F. J. B.

1132. *Longitudinal Magneto-Resistance Effect in Single Crystals of Iron.* **W. L. Webster.** (Roy. Soc., Proc. 113. pp. 196–207, Nov. 1, 1926.)—Single crystal rods of iron which have been formerly used in investigations of magnetostriction are used. Longitudinal magnetic fields up to 3000 gauss can be employed and the drop of potential along a fixed length of the rod measured by a potentiometer while a steady current is maintained through the rod. Measurements for three orientations of the axis of the rod are given. For the (100) axis there is no change in the resistance, for the (110) axis there is no change up to about 800 c.g.s. units and the resistance then rises to a limiting value corresponding with magnetic saturation of the specimen. The limiting value of dR/R is about 0·28 %. For the (111) axis a similar result is found, but the change of resistance is rather larger, the limiting value of dR/R being about 0·40 %. These results are satisfactorily explained in terms of the orientation of the atoms. A. Wh.

1133. *Dependence of the Electrical Resistance of Nickel Steels upon Composition, Temperature and Heat Treatment.* **F. Ribbeck.** (Zeits. f. Physik, 39. 10–11. pp. 787–812, 1926.)—Continuing the account given in the previous communication [see Abstract 464 (1927)], tables are given showing the electrical resistance of nickel steels between 300 and 1000° C. and at the temperatures of solid CO_2 and liquid air (−78° and −185° C. resp.). Curves are shown of the specific resistance σ and the temperature coefficient $\frac{1}{\sigma}\frac{d\sigma}{dt}$, covering the whole range −185 to 1000° C. For all the steels the temperature coefficient is small for very high and for very low temperatures, attaining higher values in the intermediate region. For "irreversible steels" the heating and cooling curves separate and form a closed loop, the loop moving towards lower temperatures as the nickel content is increased. From the shape of the resistance curves three characteristic temperatures are identified: (1) The temperature at which transformation terminates during heating; (2) The temperature at which the reverse transformation sets in during cooling; and (3) the temperature at which the reverse transformation terminates. In the case of "reversible steels," the heating and cooling curves practically coincide, the transformation temperature corresponding to a change in direction of the resistance curve. The characteristic temperatures (for irreversible steels—three, for reversible steels—one) are plotted against the nickel content, and the curves obtained are compared with the results of other workers using magnetic and thermal methods. Agreement is generally good. The variations of the specific resistance with the nickel content are discussed in relation to the structure changes established by other investigators. The effects of special heat treatment and of high carbon content are also considered, the latter being found to depress the transformation temperature. W. S. S.

1134. *Resistance of High-Frequency Circuits.* **R. R. Ramsey.** (Phil. Mag. 2. pp. 1213–1218, Dec., 1926.)—It has been customary to consider the resistance of the condenser small enough to be neglected so that the entire resistance of the circuit is ascribed to the coil. A method is now developed for measuring high-frequency resistance by means of the heat generated on the circuit. In every case it is noted that the resistance measured by the heat method is less than that measured by the resistance-variation method. The h.f. resistance of the coil was balanced against the d.c. resistance of a similar coil. The results show that the resistance of a good radio condenser is not excessive (*e.g.* for an 11-plate condenser set at 0·00008 mf. (about ½ max.) with 10^6∼/sec. R = 0·098 ohm) and the results of Weyl and Harris [see Abstract 772B (1925)] and of Callis [see Abstract 1451 (1926)] are entirely too large. The author suggests a probable explanation of the difference. A. B. W.

1135. *Metallic Conductivity of Solid Haloids.* **E. Friederich** and **W. Meyer.** (Zeits. Elektrochem. 32. pp. 566–576, Dec., 1926.)—The conductivity of solid halogen salts was determined by employing voltages which are greatly below the decomposition potential of the material under investigation. The material was in powder form and well dried, if necessary in absence of air, it was then moulded in a steel mould into a rod 0·2 cm. wide by 12 cm. long under a pressure of 5000 kg. per sq. cm., and sintered into a solid mass at higher temperatures an out of contact with air when necessary. Electrical contact was made by twisting a platinum wire round the ends of the rod. The conductivities of silver chloride, bromide and iodide, and of copper (cuprous) chloride, bromide and iodide were determined. The method is shown to be useful to distinguish between electron conductivity and electrolytic conduction. F. J. B.

1136. *Rule of Electrical Conductivity of Solid Bodies.* **E. Friederich.** (Zeits. Elektrochem. 32. pp. 576–577, Dec., 1926.)—It has been shown that as a first approximation the hardness of a body has its origin in the attraction of the atoms in the space lattice. The attraction is given by the expression $W^2/A^{\frac{4}{3}}$, where W is the valency of the compound and A is the atomic volume. Applying similar considerations to the electrical conductivity of solid bodies which conduct in the solid state by the movement of the metal ions, the rule was found that " in solid electrolytes the ion which carries the smallest charge is the one which moves." When both ions carry the same charge as in AgCl, AgBr, AgI, NaCl, and similar monovalent compounds, the size of the diameter of the ion seems to be the determining factor. In general, it is the metal ion which moves in these instances. F. J. B.

1137. *Conductivity of Phosphoric Acid Solutions at* 0° *C.* **A. N. Campbell.** (Chem. Soc., J. pp. 3021–3022, Dec., 1926.)—The specific conductivities of phosphoric acid solutions at 0° C. are determined over a wide range of concentrations, and the maximum conductivity is evaluated. The values of $1/k_0 . (dk/dt)_9$ are obtained from Kohlrausch's series at 18° and the author's at 0° C., which are much larger than Kohlrausch's values for $1/k_{18} . (dk/dt)_{22}$ at corresponding concentrations. The temperature coefficient is therefore decreasing with increase of temperature and will eventually become negative. J. N. P.

1138. *Thermoelectric Power of Alloys.* **E. van Aubel.** (Acad. Royale de Belgique, Bull. de la Classe des Sciences, No. 8–9. pp. 559–566, 1926.)—Note referring to the work of Beynerd, Hutchins, W. Haken [see Abstract 851 (1910)], A. W. Smith [see Abstract 533 (1911)], and others relating to the thermoelectric properties of alloys of bismuth and antimony. The author now gives the results of his investigations with the following alloys : (1) bismuth-thallium, (2) antimony-tin, (3) antimony-silver—in varying proportions from 0 to 100 % of the two metals concerned. As a general result the author considers that the observations prove that a determination of the thermoelectric power of these alloys will give as reliable indications of their constitution as the determination of their electrical conductivity. A. B. W.

1139. *Electric Polarisation of some Carbon Compounds—Geometric and Position Isomers.* **J. Errera.** (Phys. Zeits. 27. pp. 764–769, Dec. 1, 1926.)—According to the experiments described the trans- and para-isomers possess no electric moment, while the ortho- and cis-derivative exhibit a relatively large moment. The moment of the meta- is weaker than that of the ortho-isomers. The electric moment decreases in both series of isomers in the following order : chlorine—bromine—iodine—derivative. The molecular moment of the cis-ethylene is smaller than that of the corresponding ortho-benzole. The degree of association in pure solution media is strong for the ortho-and cis-derivative, weaker for the meta- and asymmetrical forms and nil or not measurable for the para-derivative. The measurements of the polarisation and the ultra-violet absorption form a strong support of the accuracy of the constitution formulæ of the di-halogen-ethylene-derivatives set up on the basis of pure chemical considerations. It also appears that the dielectric constant of a substance depends not so much on the atoms of which it is built up, but rather on the first line of their formation in the molecule. A. E. G.

1140. *Effect of Pressure on the Dielectric Constant of Benzene.* **L. Cagniard.** (Comptes Rendus, 183. pp. 873–875, Nov. 15, 1926).—Using a method previously described [see Abstract 2697 (1926)] for the precise determination of the dielectric constants of materials at high frequency, benzene is studied in an electric field of 650 volts (effective) per cm., and of frequency corresponding to a wave-length of 6425 metres, at pressures up to 22 atmospheres, and at various temperatures. The experimental precautions taken to obtain thermal equilibrium are described. Values are obtained for the coefficient de/dp (p = pressure) which are of the same order as, but do not accord exactly with, those calculated from the coefficient of compressibility according to Debye's theory of dielectric constants. A. B. C. L.

1141. *Dielectric Constants and Pressure in Gases.* **K. Wolf.** (Phys. Zeits. 27. pp. 588–591, Sept. 15, 1926.)—A detailed examination. In CO_2, N_2, O_2, H_2 the relations are linear from $p = 0$ to $p = 500$ to 1200 mm. In H_2O vapour they are linear from 0 to about 8 mm., then present a kink and are thereafter linear with a steeper ascent. In NH_3 there is a kink at about 20 mm., followed by a linear curve with a gentler ascent. The details vary with the construction of the condenser. It can be inferred that a layer of moisture on the condenser plates must be less than 10^{-7} cm. thick. A. D.

1142. *Dielectric Constant of the Base of Small Rods.* **J. J. Bickerman.** (Phys. Zeits. 27. pp. 769–771, Dec. 1, 1926).—This is a mathematical paper in which the question of the dependence of dielectric constants on the temperature and strength of the field is approached by combining Poisson's theory of induction with the statical observations of Langevin. A. E. G.

1143. *Dielectric Constants of Electrolyte Solutions. Part III. Solutions of Salts in Acetone, Benzonitrile, o-Nitrotoluene and Methyl Cyanoacetate.* **P. Walden** and **O. Werner.** (Zeits. phys. Chem. 124. pp. 405–426, Dec. 30, 1926.)—The salts investigated consist of mono- and poly-alkylated ammonium salts. In most cases these salts lower the dielectric constant of the solvent, the greatest depressions being caused by tetra-alkylammonium salts, *p*-anisyldiphenylmethyl perchlorate, barium perchlorate and tetra-ethylammonium styphnate. The incompletely alkylated ammonium picrates mostly occupy medium positions, whereas the incompletely alkylated chlorides and inorganic mercury compounds, in particular mercuric cyanide, produce slight depressions of the dielectric power of the solvent. An increase of this dielectric power caused by certain salts is related to the appearance of associated products with dipole moment. The above results are discussed in relation to the distinction between strong and weak electrolytes developed in earlier papers [Abstract 2359 (1925)]. The results obtained with acetone solutions by the dielectric method are in agreement with those furnished by the conductivity method in the same solvent. T. H. P.

1144. *Measurement of Small Current Variations.* **Krutzsch.** (Archiv f. Elektrot. 17. pp. 465–466, Jan. 6, 1927.)—An arrangement is described whereby small variations of current may be measured by means of a sensitive galvanometer arranged in a circuit shunted across a switch in the main circuit. A second shunt across the same points contains a battery and suitable resistance, the battery being connected so as to balance the current through the galvanometer due to the main current. By properly choosing the resistances of the two shunts the galvanometer may be made to show changes of 10^{-5} amperes in the 1-ampere main-circuit current. A. W.

1145. *High-Voltage Direct-Current Generator.* **S. S. Mackeown.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 727–729, Dec., 1926.)—The requirements to be met for the high-voltage generator for certain experiments were that the voltage should have only a very small ripple, that no damage should result from a short-circuit, and that the apparatus should be relatively inexpensive. The generator was designed to operate at a maximum voltage of 50,000 volts with an output of about 100 watts and a ripple of less than 0·1 %. The arrangement used was to couple a valve generator to a Tesla coil, and then to rectify the voltage developed across the coil. A 250-watt valve was used for the generator, a 2000-volt d.c. machine being used to supply the anode circuit; a filter was introduced in the supply leads to suppress ripples in the voltage. The voltage across the large coil was rectified with a 100,000-volt General Electric kenotron. The coil was connected in series with a bank of Leyden jars with a capacity of about 0·005 microfarad. The generator could be adjusted so as to operate at the resonance frequency of the main circuit, including this condenser, the large coil and the kenotron. The output was taken from the terminals of the Leyden jar condenser. A diagram is given of the variation with time of the output voltage. The variations actually found were mainly due to variations in the anode supply to the generator. The maximum output obtained was 2 milliamperes at 40,000 volts and 140 kilocycles. A. W.

1146. *A Kathode Oscillograph with Equally Distributed Concentrating and Deflecting Fields.* **B. L. Rosing.** (U.S.S.R. Sci. Techn. Dept. Moscow, No. 147. pp. 8–9, 1926. In German.)—The Brown-Wehnelt kathode tube excels other oscillographs in that its kathode bundle does not show inertia and follows accurately the changes of the electric and magnetic fields up to a frequency of 100 millions per sec. Its drawback is that the fluorescent patch produced on the screen is not sharply defined, which leads to a weak and indistinct curve in the current registration. The ring-shaped coils which have been used to bring the kathode bundle to a point cause disturbances, and the author has devised a method of concentrating the bundle in which the concentrating magnetic field by means of an equally distributed winding over the whole length of the tube is made homogeneous. Moreover, the deflecting electric field is produced by a condenser whose plates extend over the whole length of the tube.

This field is thus also homogeneous and crossed with the concentrating magnetic field. The movement of the kathode bundle in a tube so arranged was investigated and a formula found which gives the relation between the deflection of the kathode bundle and the strength of the condenser field. Between the two magnitudes a strict proportionality exists and the concentrating action of the magnetic field is not disturbed. A tube thus constructed produces a bright fluorescent patch of about 0·1 mm. diameter. The formula mentioned is: $D = 35E/H^2$, where D is the deflection of the patch in cm., E the intensity of the electric field in volts/cm., and H the intensity of the magnetic field in c.g.s. units.
J. J. S.

1147. *The Vibrometer.* **H. Nukiyama** and **M. Matsudaira.** (Imp. Acad. Tôkyô, Proc. 2. pp. 410–413, Oct., 1926. In English.)—The vibrometer is a new apparatus which provides a means to measure vibrational mechanical impedance by measuring motional mutual impedance with an alternating-current potentiometer. The instrument consists of an electromagnet comprising a central pole-piece surrounded with a flat plate with a central hole, thus giving an annular space in which there is uniform radial field. In this space there is arranged a light-former carrying two windings some little distance apart. There is associated with each winding a compensating winding on the pole-piece of the same number of turns so connected that the two fields neutralise. One set of these windings is termed the "driving winding," the other the "measuring winding." The former carrying the coils is supported in the field space by a suitable elastic member. When an alternating current is passed through the driving coil the mechanical system will vibrate, and this is observed by measuring the induced e.m.f. in the measuring coil by an a.c. potentiometer. The constants of the system may be evaluated from the motional mutual impedance circle. The mechanical impedance to be measured, such as a microphone diaphragm, is then attached to the coil-former and its value determined for any required range of frequencies of the driving current. F. S. B.

1148. *The "Molecular Movements" of Sensitive Moving-Magnet Galvanometers.* **A. V. Hill.** (Journ. Sci. Inst. 4. pp. 72–73, Dec., 1926.)—A discussion is given of the random movements of the system of a sensitive moving-magnet galvanometer, on the assumption that these have a mean energy equal to one-third of that of a gas molecule at the same temperature. It is shown that these movements are of importance at sensitivities now practically attainable, and certain deductions are made in connection with the design of galvanometer systems. AUTHOR.

1149. *The Wilson Cloud Expansion Chamber.* **A. W. Simon** and **D. H. Loughridge.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 679–690, Dec., 1926.)—Describes a form of the apparatus with a number of improvements which make it more convenient in use and more certain in operation. The chamber itself is much larger than any previously described, and the apparatus is arranged so that it is possible to duplicate the expansion ratio accurately in successive experiments, working always with that which gives the best results. Accurate timing of the events of each experiment is obtained by means of a number of adjustable commutators, mounted on a common axle, to which the timing pendulum is attached. The air in the chamber is carefully cleared from ions and other particles about which condensations can be formed, and the construction is such that disturbing air currents are avoided. Special precautions are taken to avoid leaks in the different parts of the apparatus. The tracks produced by X-rays and γ-rays have been mainly investigated; they are rather faint, and accurate adjustment is needed, while with α-rays, owing to the intensity of the ionisation, the tracks are obtained and photographed easily with simple apparatus. The methods employed with X- and γ-rays are described, and the advantages and disadvantages of an arc light and of an exploded wire in photographing the tracks are discussed. H. N. A.

1150. *An Accessory Device for Potentiometers.* **P. A. Borden.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 601–602, Nov., 1926.)—This is a device found useful in checking wattmeters and in the exact measurement of low resistances. It is used in connection with the Leeds and Northrup " K " potentiometer and requires no structural change in the instrument itself, consisting actually of a double-throw four-pole switch. A diagram of the circuit is given and the method illustrated by a description of the testing of a wattmeter. [See also Abstract 2155 (1925).] A. A. D.

ALTERNATING CURRENTS AND MAGNETISM.

1151. *Field Equations of the Oscillating Dipole.* **F. Pollaczek.** (Elek. Nachrichten. 3. pp. 433–438, Nov., 1926. From the Telegraphentechn. Reichsamt.)—The paper, which is a mathematical discussion, deals with the field equations of the oscillating dipole and their consequences. F. S. B.

1152. *Inductance of a Helix.* **C. Snow.** (Bureau of Standards, Sci. Papers, No. 537. pp. 431–519, 1926.)—In this mathematical paper the formula for the direct-current inductance of a single-layer helix which is obtained takes account of the helical shape of the wire and hence of the axial component of current. It does not assume uniform current density over the section of the wire, but is correct to the second order for any current distribution which may be expanded by Maclaurin's theorem over the section of the wire. The formula is derived from the fundamental equations of the magnetic field and takes account of the periodic structure of the field, which is important in the vicinity of the wires. The inductance of a helix is given in the form

$$\mathrm{L}_s = \int\int u(x_1y_1)d\mathrm{S}_1\int\int u(x_2y_2)d\mathrm{S}_2\mathrm{M}(x_1y_1x_2y_2),$$

where the integration is performed twice over any section of the wire, where $u(xy)$ is the magnitude of the current density at a point xy of this section, and where $\mathrm{M}(x_1y_2x_2y_2)$ is a symmetrical function of the two points $\mathrm{P}_1(x_1y_1)$ and $\mathrm{P}_2(x_2y_2)$ in this section. It represents the mutual inductance between two unit current helical filaments of the same pitch, $2\pi p$, and axial length $l = 2\pi p\mathrm{N}$, which pass through these two points. J. J. S.

1153. *Electric Filter Circuits.* **M. Wald.** (Archiv f. Elektrot. 17. pp. 455–465, Jan., 1927.)—A mathematical treatment in which the impedance of the network is obtained as the quotient of two determinants. From this an iterative formula is deduced for infinitely long networks.
A. W.

1154. *Ferromagnetic Properties of Ferric Oxide.* **H. Forestier** and **G. Chaudron.** (Comptes Rendus, 183. pp. 787–789, Nov. 8, 1926.)—It was shown in a previous paper [see Abstract 1669 (1926)] that the magnetisation of ferric oxide increased with the temperature up to 600° C. and then suddenly decreased up to 675° C. The curve of cooling is different from that of heating below 600° C., and the coefficient of magnetisation increases from that temperature down to normal temperature. Further work on the same samples of ferric oxide has shown that rigorously reversible curves could be obtained which coincided with those of the earlier work. The magnetisation was destroyed by heating above 675° C. and cooling outside the magnetic field. The original values of the magnetisation at ordinary temperatures were then obtained. Similar properties were observed for magnetite, ferrites, such as barium ferrite.
F. J. B.

1155. *Structure of the Atomic Magnet and the Mechanical Effects of Magnetisation.* **R. Forrer.** (Comptes Rendus, 183. pp. 738–741, Nov. 3, 1926.)—The approach of neighbouring atoms in a solid is limited by the electrostatic repulsion of the outer electronic orbits. The volume of the solid is hence determined by the size and arrangement of these superficial orbits, and changes in their arrangement will be accompanied by changes in volume. Magnetostriction may be explained in this way, and two reversible varieties are distinguished; in one of these there is rotation of the magnetic multiplet [Abstract 484 (1927)], whilst in the other the constituents of the multiplet approach one another. As an example of the second kind, a mass of mixed crystals in an intense field undergoes negative magnetostriction, there being a contraction in the direction of the field. In nickel the negative effect occurs as a consequence of the rotation of the magnetic doublet. A third species of magnetostriction is caused also by the rotation of the multiplet, but is also related to the position of this body in the lattice. In weak fields the effect is negative in nickel and positive in iron.
G. E. A.

1156. *Oscillations, and Resonance of Elementary Magnets.* **W. Arkadiew.** (Comptes Rendus, 183. pp. 777–779, Nov. 8, 1926.)—An apparent permeability is found in considering the damping of electric waves by a grating of magnetic wires. This is considered from the standpoint of Weiss' theory of elementary magnets and a number of curves given to illustrate the results.
F. S.

1157. *The Dielectric Constant and Diamagnetism of Hydrogen and Helium in the New Quantum Mechanics.* **J. H. van Vleck.** (Nat. Acad. Sci., Proc. 12. pp. 662–670, Dec., 1926.)—The new Heisenberg-Schrödinger quantum mechanics has enabled the exact calculation of the diamagnetic and dielectric susceptibilities of hydrogen atoms, and it is shown by the author that whenever the quantum numbers are small the numerical values for these susceptibilities differ from those of the older quantum theory and are usually in more convincing agreement with experiment. The dielectric constant of atomic hydrogen in the normal state is first considered in the paper and followed by that of excited hydrogen atoms and diamagnetic susceptibility. Application is then made to helium and molecular hydrogen. [Abstract 2199 (1926)] should be consulted. H. H. Ho.

1158. *Magneto-Spectroscopic Investigations with Nickel Wires using Short Hertzian Waves.* **H. Israël.** (Zeits. f. Physik, 39. 10–11. pp. 841–857, 1926.)—The method of Gans and Loyarte was employed to determine the "apparent permeability" spectrum of nickel wires (Abstract 1470 (1921)]. The method is based on a measurement of the impedance of the wires by means of the decrement of the resonance curves. Short waves were produced by means of Mie exciters [see Abstract 127 (1911)], the source of energy employed being a machine of 500 periods. The wave-length and damping were measured by means of a double-wire Lecher system, the wave-indicator being an iron-constantan couple. The spectrum is found to be very complicated, numerous maxima occurring for wave-lengths up to 50 cm, after which the maxima are much fewer and not so pronounced. The magnetic history of the wire does not affect the spectrum. G. E. A.

1159. *Susceptibility of Gases, Curie's Law, and Diamagnetism of Flames.* **W. Gerlach** and **E. Lehrer.** (Ann. d. Physik, 81. pp. 1129–1134, Dec. 11, 1926.)—Two methods are described by means of which it can be demonstrated to a class that an upward current of hot gas is deflected, on passing through an inhomogeneous magnetic field, in the direction of the inhomogeneity. In one case the indicator is a differential thermocouple; in the other the deflection of the gas current is made visible. Faraday's well-known experiment to demonstrate the "diamagnetism of gas flames" cannot be regarded as unambiguous. [See also Abstract 485 (1927).] G. E. A.

1160. *Effect of Pressure on the Magnetisation of Magnetite.* **L. A. Welo.** (Science, 64. pp. 453–455, Nov. 5, 1926.)—Magnetite has been shown to be oxidisable to Fe_2O_3 without loss of its ferromagnetism and without change of its crystal structure [Abstract 2393 (1925)]. A short cylinder of Californian magnetite was partially demagnetised and tested magnetometrically in a hydraulic press. At a pressure of 1200 atmospheres and with a magnetising field of 39·1 gauss, the change of magnetic moment is about 50 % greater than the corresponding change at atmospheric pressure. The bearing of this result on the questions of earth magnetism is discussed. G. E. A.

1161. *Comparison Measurements between the Abinger and the N.P.L. Standard Horizontal Force Magnetometers.* **D. W. Dye.** (Terrest. Magn. 31. pp. 177–185, Dec., 1926.)—The construction and use of the N.P.L. magnetometer have been described by F. E. Smith [Phil. Trans. 223. p. 178]. A second similar instrument has been set up at the new Royal Magnetic Observatory at Abinger, Leith Hill. The dimensions of the windings are five-sixths those of the original instrument and minor improvements have been introduced, otherwise it is of the same design and arrangement as its prototype. Before installing the magnetometer at Abinger the two instruments were set up at the N.P.L. on two stone piers about 2 metres apart and their performances compared. The line joining their centres was approximately magnetic east and west. The comparison consisted in alternate measurements of H by the two instruments. As the difference between the value of mean H determined by them is only $0 \cdot 6\gamma$ and is the same for each series of measurements, the agreement between the two magnetometers may be considered extremely satisfactory. E. F.

1162. *Magnetisation at Low Temperatures.* **P. Debye.** (Ann. d. Physik, 81. pp. 1154–1160, Dec. 11, 1926.)—The Langevin formula is capable of representing paramagnetic saturation such as that demonstrated experimentally in the case of gadolinium sulphate by K. Onnes. It is shown that the formula, in spite of its experimental confirmation, cannot be exact, since consequences follow which contradict the Nernst heat theorem. An attempt is made to find from the formula a quantitative result for the temperature change in an adiabatic magnetic process. The change appears to be relatively large, and gives rise to the question whether by the aid of such a process the absolute zero might be reached. G. E. A.

1163. *A Simple Method for the Determination of the Ratio of the Earth's Horizontal Field to the Movement of a Magnet.* **C. Schmidt.** (Phys. Zeits. 27. pp. 715–716, Nov. 15, 1926.)—The magnet is placed horizontally with its N pole pointing N. The field round it is explored with a small compass needle and by following the procedure outlined the neutral points which lie to E. and W. can be very accurately found. The mathematical considerations underlying the method are given. A. A. D.

1164. *Earth Current Observations on the Mountains.* **V. Oberguggenburger.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 3–4. pp. 99–116, 1926.)—The magnitude and direction of the e.m.f. was measured in the Alps for various points having different heights and different inclinations of the ground to the horizontal. Earth plates were sunk at distances apart >700–1000 m. and the e.m.f. obtained by a null method with the help of a potentiometer. To find the effect of weather changes on these results simultaneous observations of pressure, temperature, humidity and wind speed were made. The e.m.f. of the earth current in the mountains lies between 0·18 and 0·50 volts/km., while the vertical component of the earth current appears to be constant in the regions tested and of the magnitude 0·4 volts per km. difference of height. A series of graphs illustrates the changes of e.m.f. with varying conditions of sky, temperature, pressure and humidity. Through the day the e.m.f. has a double wave change with two maxima, the times for which depend on weather conditions. Temperature and humidity vary in a way similar to the e.m.f. but the pressure changes inversely. The effects of showers and thunderstorms on the e.m.f. are also stated. The earth current in the regions tested flows from south to north, but the actual direction varies with the locality. It is constant throughout the year. The effects of weather conditions are more pronounced, for a flow inclined to the horizontal and stronger as the inclination increases, giving to the e.m.f. a bigger amplitude. Variation of the measured earth currents in inclined conductors ought, however, to be limited in the main by the state of the atmosphere. R. S. R.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

1165. *Production of High-Voltage Kathode Rays Outside the Generating Tube.* **W. D. Coolidge.** (Frank. Inst., J. 202. pp. 693–721, Dec., 1926.)—This paper is essentially similar to a previous popular article on the subject [see Abstract 390 (1926)], but gives more detailed particulars, with illustrations of the Lenard-Coolidge electronic discharge tube used and the various methods of its high-tension excitation. The construction of the Lenard window is also described in detail, and the possibilities of using several tubes in parallel with still higher voltages are considered.

B. J. L.

1166. *Some Experiments with High-Voltage Kathode Rays outside the Generating Tube.* **W. D. Coolidge** and **C. N. Moore.** (Frank. Inst., J. 202. pp. 722–735, Dec., 1925.)—This is a further extension of a previous paper [see Abstract 390 (1926)] and describes the effects of kathode rays upon various crystals, insulators, bacteria, plant and animal tissues.

B. J. L.

1167. *Oscillographic and Spectrographic Investigations of X-Ray Tubes.* **R. Glocker** and **E. Kaupp.** (Zeits. techn. Physik, 7. 9. pp. 434–444, 1926.)—Oscillographic investigations were carried out upon induction coils, closed and open core transformers and constant potential apparatus, with both gas and electron tubes. The Gehrcke oscillograph was used, and oscillographs of single impulses were obtained. Simultaneous Zeeman spectrometer investigations were made. It is found that a sine form excitation of a Coolidge tube does not give a sine form intensity of radiation, and thus an instrumental increase of current from 4 to 6 mA only alters the form of the current curve. By earthing one pole of an X-ray tube excessive oscillatory potentials are excited by coil or transformer operation. A lag of current after voltage is demonstrated and measured. The superior spectral distribution with constant potential was demonstrated. The spectral intensity formula of Behnken is shown to be applicable to high-voltage excitation. An important paper. B. J. L.

1168. *The Action of Secondary X-Rays on Micro-Organisms.* **J. J. Trillat.** (Comptes Rendus, 183. pp. 1304–1307, Dec. 20, 1926.)—The author has previously demonstrated the action of direct long-wave X-radiation upon *B. prodigiosus*, and now extends his research to the action of secondary radiation from metallic plates upon the same organisms. Using secondary radiation from Au, Pb, Pt, Bi, Ag, Sn, Ni, Fe, Zn, Cu and Al, a bactericidal action is obtained and is dependent upon the atomic number of the metal, being greatest for the heaviest metals. The action also varies with the distance between culture and secondary radiation. The results agree with those of Thibaud for secondary radiation excited by γ-rays from various metals. The experimental dispositions are described. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1169. *Ion Adsorption on Water Surfaces.* **A. Frumkin, S. Reichstein** and **R. Kulvarskaja.** (Kolloid Zeits. 40. pp. 9–11, Sept., 1926.)—The surface adsorbability of different salts of tetrapropyl ammonium are determined by measuring the surface tension by the capillary rise method. With different anions the adsorbability falls in the order $ClO_4' > I > NO_3' > Br' > Cl > F'$. This is in agreement with the measurements previously made of the potential difference between air and the surface of solutions [Abstract 2368 (1924)]. The fall in adsorbability accompanies a fall in the ionic volume with its associated rise in the hydration energy. The greater the ionic volume the smaller is the electric field on the ion surface and the greater the amount of work against the cohesion forces of the solvent on the entrance of the ion in the interior of the water on account of its larger displacement. The measurements are then extended to ascertain the influence of different kations in association with trichlorbutyric acid. No appreciable difference is observed in the adsorbability of the salts of the different alkali metals. The results which thus show that the adsorbability of inorganic salts is determined only by the nature of the anion indicate that it is only the acid and not the base which is absorbed. The assumption that the process is hydrolytic is opposed, however, by the observation that adsorption as measured by the potential difference at the air solution surface is independent of the hydrogen-ion concentration. J. N. P.

1170. *Adsorption and Diffusion in an Electric Field.* **R. Fürth.** (Phys. Zeits. 27. pp. 692–697, Nov. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1924.)—Adsorption on surfaces is controlled by electrical forces while polar adsorption occurs when a potential difference giving rise to forces of attraction occurs between adsorbing body and absorbent. On account of the potential developed by the contact of most solids with water, polar adsorption occurs of particles with a charge of opposite sign from the solid. A method which was previously employed for determining the nature of the charge and the adsorption of dyes of coloured colloidal particles is applied to simple inorganic salts. Moistened strips of a porous material such as filter paper or unglazed porcelain are held at the upper edge by metal clamps which are connected to a potential source of about 600 volts while the lower surface is immersed in the electrolyte under measurement. Salt at a certain concentration mounts up each porous electrode above the surface of the electrolyte and the concentration is determined after removal from the electrolyte. The concentration changes are determined by the combined effects of ionic migration velocities and molecular diffusion in accordance with theoretical relations which are applied. It is found that chlorides with bi- or multivalent kations are absorbed at the kathode to a greater extent than those with univalent kations. The selectivity of the electrodes is less when the valency of the anion is higher. Concentration changes on the electrodes are further examined by measurements of distribution of potential along the electrodes at different times.

In accordance with calculation the salt concentration boundary is sharper at the kathode than at the anode and this difference, due to continued diffusion of the anion, becomes more marked with time. J. N. P.

1171. *Abnormal Absorption of Gases by Steel.* **T. C. Sutton** and **H. R. Ambler.** (Faraday Soc., Trans. 22. pp. 406–416; Disc., 417–419, Nov., 1926.)—Steel dust is exposed to the instantaneous high pressures and temperatures produced by cordite explosions and is found to absorb as much as 30 c.c. of gas per gramme. Desorption is brought about by pumping off the gas at temperatures between 600° C. and 1000° C. The absorption of 1 c.c. of mixed gases is accompanied by an energy evolution of about $\frac{3}{4}$ gramme calorie. Of the absorbed gases CO_2 is the most readily desorbed, N being firmly retained, due possibly to its presence as iron nitride. The evidence is against the supposition that other absorbed gases, *e.g.*, those containing O_2, are held in chemical combination to any considerable extent. In the *Discussion*, **J. N. Pring** considers that the heat of reaction and subsequent difficulty in afterwards eliminating the gases points to chemical action, and suggests that the steel dust so treated might possess special properties as a catalyst in different gaseous reactions. The authors remark in reply that a number of substances, including both steel and Cu, have been found which act as catalysts under the conditions described, the formation of CH_4 and NH_3 being favoured. A. B. C. L.

1172. *Adsorption of Nitrogen at Low Pressures by Activated Charcoal.* **R. Chaplin.** (Phil. Mag. 2. pp. 1198–1207, Dec., 1926.)—A specially modified design of McLeod gauge is employed for the determination of the isotherm at 25° C. for N and steam-activated coco-nut charcoal evacuated for four hours at 800° C., between the pressure limits 2×10^{-4} and $1{\cdot}3 \times 10^{-2}$ mm. Hg. The results indicate that the amounts of N adsorbed at such low pressures are exceedingly small and that only with pure chemical N can consistent results be obtained. Atmospheric N gives irregularities and very marked hysteresis, the impurities entirely masking the results. The quantity of N adsorbed is a linear function of the pressure. Equilibrium is rapidly attained and the isotherm is found to be reversible. A. B. C. L.

1173. *Principles of Colloid Chemistry.* **J. W. McBain.** (Kolloid Zeits. 40. pp. 1–9, Sept., 1926.)—The two main aspects of colloidal science are defined as structure and stability. The stability of colloidal aggregates is related to the particles being composed of micellæ as elementary units. A discussion is given of the views which have been put forward on the structure of soap micellæ and those of cellulose, together with the evidence from X-ray examination. In many instances this examination has pointed to the particle possessing a crystal structure. The stability and the main properties of sols are, however, determined not by the internal structure but by the condition of the surface and the presence of a stabilising agent. Micellæ are probably surrounded by a Helmholtz electrical double layer and the stability is controlled by the opposing forces of gravitation and the electrostatic attraction of free ions, and the minimum stability occurs at the isoelectric point. Reference is made to aggregation and its influence on viscosity; hydration; "electroviscous" effect; the network structure of jellies; pepsisation of gels by stabilising agents to give aggregate of micellæ; the use of molecular sieves prepared from mineral sections; the conditions for the stability of sols; solvation and the manner in which it is controlled by the electrical double layer; electrokinetic and contact potentials of micellæ; the operation of the Donnan distribution law; the interaction of colloids to produce sensitisation, mutual coagulation, or protection action; the action of electrolytes on colloids. J. N. P.

1174. *The Antagonistic Actions of Ions in the Neutralisation of Sols. Part II.* **H. B. Weiser.** (J. Phys. Chem. 30. pp. 1527–1537, Nov., 1926.)—The addition of a small fraction of the precipitation concentration of alkali chloride to an arsenious sulphide sol results in agglomeration of the particles with a consequent decrease in the stability of the sol. With an arsenious sulphide sol the higher precipitation value of barium chloride in the presence of alkali chloride is due for the most part to kationic antagonism rather than to the stabilising influence of chloride ion. The addition of potassium ferrocyanide to copper ferrocyanide sol increases the stability of the sol toward all electrolytes, owing to strong adsorption of ferrocyanide iron. Kationic antagonism plays a minor rôle in the precipitation with mixtures of barium chloride and potassium ferrocyanide. The antagonistic action of salt pairs on protoplasm is determined by their effect on the permeability of the cell membrane. The membrane of a living cell may be a colloidal film similar to a colloidal sol that can undergo reversible coagulation. If so, there would appear to be a close analogy between the action of salt pairs toward such sols as copper ferrocyanide and arsenious sulphide and the antagonistic action of salt pairs on the permeability and hence on the life and growth of living cells. [See also Abstract 1159 (1926).] J. N. P.

1175. *Regular Ridges in Fractures of Acroleïne Gels.* **C. Dufraisse and P. Gailliot.** (Comptes Rendus, 183. pp. 967–969, Nov. 22, 1926.)—The examination of shock fractures of gels produced in resins resulting from the catalytically assisted condensation of acroleïne reveals a regular ridge formation, the furrows being spaced at about 120 per mm. and exhibiting diffraction phenomena. An illustration is given of a spectrogram showing absorption at 4358 Å., 5461 Å., and 5769 Å. Examination of an impression of the surface in collodion suggests that the effects are produced by the occurrence of fine cracks in a smooth surface. The spacings may vary regularly, and may be convergent (fan-shaped). It is considered that they are related to a pre-existing structure in the gels before fracture. A. B. C. L.

1176. *Equilibrium in Colloid Systems. Part II. Coagulation.* **O. K. Rice.** (J. Phys. Chem. 30. pp. 1660–1668, 1926.)—From a consideration of the change of free energy which accompanies a change of the size of colloid particles, it is shown that dispersion is a stable state if the surface tension of the large particles is negative and coagulation is a stable state if the surface tension is positive. By applying the laws for the surface tension of electrically charged surfaces the stability of charged colloids in salt solutions is considered. These considerations show that a dispersed system will coagulate at certain definite concentrations and potentials of the particles which are such that the surface tension is zero. The possibility is considered (1) that the interior of the colloid particle may be neutral, the surface being charged with a diffuse layer of ions in the surrounding solution, or (2) that there may be no charge at the surface of the particles, but two diffuse layers of ions, one in the solution surrounding the particle and one in the particle. The various considerations mentioned are discussed in connection with the precipitation of arsenious sulphide sols. [See also Abstract 1485 (1926).] J. N. P.

1177. *Properties of Large Molecules in Solution.* **N. Marinesco.** (Comptes Rendus, 183. pp. 964–966, Nov. 22, 1926.)—It was shown by previous work that certain coloured molecules were surrounded in solution by a perisphere of the monomolecular solvent such as water and monohydric alcohols, the number of molecules so fixed remaining constant for the solvent, and which is characteristic for the substance dissolved. The investigation has been extended to saccharose, uranine, rhodamine B, eosin, erythrosine, and bengal red. The ratio C/S, where C is the number of dipoles adsorbed, and S the surface of the large molecule, was determined for the substances given. The conclusion is drawn that the law of Stokes is valid for large molecules. F. J. B.

1178. *Rate and Mechanism of the Aeration of Water under Open-Air Conditions.* **W. E. Adeney.** (Phil. Mag. 2. pp. 1140–1148, Nov., 1926.)—The solution of gases in water was studied under varying conditions, such as occur in the purification of sewage. The solution of gases in well-mixed water in thin films was determined by enclosing a large bubble of air of known volume in a long, narrow tube containing a known volume of deaerated water. The bubble was allowed to ascend through the water repeatedly until saturation of the water by air was reached. The air-water surface remained unbroken throughout the experiment. The loss of pressure in the bubble of air was taken as a measure of the quantity of gas dissolved. Formulæ were obtained from the results which enable the rate of solution to be calculated. The solution of gases by quiescent columns of water was investigated by exposing 10-ft. columns of water and solutions of sodium chloride to air. The mixing of the saturated surface solution with the remainder of the water is explained as due to evaporation and consequent concentration of the surface layer, which then sinks. The results of the investigation are discussed in connection with water and sewage purification. F. J. B.

1179. *Nature of Solutions of the Strong Acids from the Standpoint of the Salt Effect. The System : Nitric Acid-Sodium Nitrate.* **L. H. Angus** and **H. M. Dawson.** (Leeds Philosoph. and Lit. Soc., Proc. 1. pp. 104–107, 1926.)—The effect of the addition of salts on the solubility of iodine in water conforms to a simple experimental relation of the form $s = S_0e^{-kc}$, where S_0 is the solubility in pure water, s that in a salt solution of concentration c, and k is a constant depending on the nature of the salt. An anomalous behaviour is shown by solutions of free acids. Sulphuric acid reduces the solubility, whereas nitric acid raises it. The solubility of iodine in pure water, 1·3 N and 2·7 N solutions of nitric acid in the presence of varying quantities of sodium nitrate is measured. In close agreement with the experimental formula, the values of log s plotted against the concentration of sodium nitrate give three parallel straight lines for the three media. The results indicate that the condition of the acid is not appreciably affected by the addition of salt, which is consistent with the supposition that the proportion of non-ionised acid is very small. This view is also in agreement with the observation that vapour-pressure determinations show that the partial pressure of nitric acid in aqueous solutions falls rapidly with diminution of the concentration, indicating the early attainment of complete dissociation. J. N. P.

1180. *Hydrogen-Ion Concentration and Activity and the Theory of Solution.* **L. Ebert.** (Kolloid Zeits. 40. pp. 169–174, Nov., 1926.)—The author discusses the question whether and in how far ions may be considered as ideal dissolved molecules. According to the osmotic theory the e.m.f. E of a concentration cell depends merely upon the ratios of the concentration $E = k \log (C_{H+})_1/(C_{H+})_2$ (Nernst). The modern theory also takes the electrostatic condition of the solution of the ions into consideration. The above equation only holds in the exceptional case when the mean electrostatic condition remains unchanged and an alteration of the potential of a solution may be caused both by chemical reactions and by polar effects. Thus the potential difference depends upon the ratio, not of the concentrations, but of the ionic activities (A_{H+}). These latter become important at higher concentrations and with polyvalent ions. Disregard of this fact may account for discrepancies in the tests of buffer batteries, which are generally ascribed to faulty measurements. H. B.

1181. *Equilibrium Pressure of Hydrated Salts.* **F. J. Norton** and **J. Johnston.** (Am. J. Sci. 12. pp. 467–476, Dec., 1926.)—It is deduced theoretically that the measurement of the equilibrium pressure of the system $S_2 - S_1 - V$ (S_2 and S_1 being a pair of adjacent hydrates of a salt) may be replaced by that of the system $S_2 - S_1 - L' - V$, where L' is the solution saturated with both S_2 and S_1 and containing a third solute in amount sufficient to lower the transition temperature $S_2 \rightleftarrows S_1$ to the temperature desired; and that the result is independent of the nature of the added solute provided only that both S_2 and S_1 are present as solid phases. These conclusions are supported by measurements made on the system $Na_2SO_4 10Aq - Na_2SO_4 - H_2O$, the added solute being NaCl, $NaNO_3$, and H_2SO_4. The equilibrium pressure (p, in mm.) of this system is given by the equation $\log p = -2710/T + 10{\cdot}370$, at temperatures down to 0° C. A. B. C. L.

1182. *Transition Temperature and Solubility of Sodium Sulphate in the Presence of Sodium Chloride or Sodium Bromide.* **F. J. Norton** and **J. Johnston.** (Am. J. Sci. 12. pp. 477–483, Dec., 1926.)—Measurements required in the preparation of a previous paper [see preceding Abstract] are described of the lowering of transition temperature of $Na_2SO_4 . 10H_2O$ by NaCl and NaBr, and of the concentration of halide and of sulphate in the solution in equilibrium with the pair of solid phases $Na_2SO_4 . 10H_2O$ and Na_2SO_4 at these temperatures. Examination of the results shows that NaCl, NaBr, NaI, and glucose are all practically equally effective in lowering the transition temperature, although they differ markedly in repressive effect upon the concentration of sulphate in the solutions. A. B. C. L.

1183. *Vapour Pressures of Aqueous Solutions of Potassium Nitrate at 20° C.* **J. C. W. Frazer, B. F. Lovelace** and **R. K. Taylor.** (J.

Phys. Chem. 30. pp. 1669–1677, Dec., 1926.)—The experiments previously made with potassium chloride [see Abstract 630 (1916)] have been continued with potassium nitrate, which proved to be nearly an ideal solute, as expected. Modifications of the apparatus and of the mode of working are described. The concentration range was 0·1 to 2·9 N. The law of Babo is not even approximately obeyed, except by very dilute solutions of very small heats of solution. H. B.

1184. *Anomalous Osmosis through Collodion Membranes.* **P. J. Jurišić.** (Phys. Zeits. 27. pp. 774–778, Dec. 1, 1926.)—An investigation is made of the electrokinetic effect observed by Loeb whereby the rate of osmosis through a collodion container in which a salt solution is placed reaches a maximum value at concentrations between *m/256* and *m/515*. The limiting rate of osmosis is conditioned by the setting up of a positive charge on the surface of the membrane through adsorption of anions, an effect which increases with the valency of these ions. Further measurements are made over a wide range of concentrations with sodium sulphate solutions and with isotonic glucose solutions of the rates of osmosis of the distilled water into the salt solution and the potential difference between membrane and solution. Anomalous osmosis is observed at concentrations of about *m/32* and above, when the change of concentration of salt becomes only small and irregular. A big decrease in the rate of osmosis is brought about by addition of hydrochloric acid, and sodium hydroxide causes an increase at concentrations of *m/32* and higher of sodium sulphate, while below this concentration a decrease is produced. Parallel changes are produced in the surface potential. J. N. P.

1185. *Thermodynamic Properties of Colloidal Solutions from Measurements with the Ultra-Centrifuge.* **A. Tiselius.** (Zeits. phys. Chem. 124. pp. 449–463, Dec. 30, 1926.)—In continuation of former work on molecular weight determinations of colloidal molecules by measurements of sedimentation velocities and equilibria on centrifuging, an investigation is made of the thermodynamic relations which apply with colloidal molecules in the presence of electrolytes with which they may partially combine giving an equilibrium concentration of a colloidal ion. The mass of this ionic combination is taken as equal to that of the original large molecule, and sedimentation of the added electrolyte is neglected on account of the relatively small size of its molecule. The difference of free energy which is brought about by the change in concentration of a component may be compensated by the change of other variables, such as pressure, temperature, e.m.f., which influence the free energy in a known manner. In the present treatment centrifugal force is introduced as a new variable. A curve is plotted to give the variation of the concentration C with the distance from the centre, when, assuming the applicability of the gas laws, $F = RT \log C$ and $M = -\frac{RT}{\pi'' - \pi'} \log \frac{C''}{C'}$, where M is the molecular weight and π' and π'' are the centrifugal potentials at two zones of concentration C′ and C″. Any difference in molecular weight from data at different parts of the curve denotes a departure from the gas laws, such as by aggregation. By conducting measurements at different concentrations it can be ascertained if the different particles are in aggregation equilibrium with each other or as an independent mixture. The case is considered where the kations of the electrolyte are partially absorbed by the colloid. The segregation on centrifuging thus leads to a potential difference which is the same as the Donnan potential and acts against the centrifugal force. The influence of this factor on the equilibrium is calculated thermodynamically. [See also Abstract 1998 (1926).] J. N. P.

1186 *Ionic Volumes and Hydration.* **N. R. Dhar.** (Zeits. Elektrochem. 32. pp. 596–598, Dec., 1926.)—The author suggested in 1913, for various reasons, that the ions occupy a smaller space than the undissociated molecules. He ascribed the contraction of 20 cm.^{3} observed on neutralising a litre of acid by a base to the combination of $H^{\cdot}$ and OH' to water, and points out that the molecular volumes of electrolytes are much smaller than the molecular volumes of non-electrolytes in solution. This he demonstrates for the alkali chlorides with the aid of the Kohlrausch-Hallwachs formula for the molecular volume. Substances like LiCl and H_2SO_4, which have a strong affinity for water and are strongly dissociated, show only a small decrease of this kind. The pronounced hydration of the ions of lithium and calcium is not due to the greater density of their electric surface charge, but to the marked affinity for water. Similarly the lyophile colloids are more strongly hydrated than the lyophobe [Abstract 2621 (1925)]. The author finds an analogy to these relations in Eddington's view that the density of the residual nucleus of an atom is, after emission of an electron, greater than that of the atom before the emission. H. B.

1187. *Ionic Sizes and their Relationship to Crystal Structure Type, Solid Solution and Double-Salt Formation and the Stabilities of Hydrates and Ammoniates.* **E. J. Cuy.** (Am. Chem. Soc., J. 49. pp. 201–215, Jan., 1927.)—Evidence is presented which shows that, in general, for univalent and bi-bivalent salts the sequence of structure types CsCl, NaCl, ZnS, and ZnO is parallel to the order of ionic radii ratios ($R_{large}:R_{small}$), as predicted on the basis of the assumptions (*a*) that the spheres of influence of adjacent oppositely charged ions are mutually tangent; (*b*) that the spheres of influence of like ions cannot interpenetrate; and (*c*) that, the above limitations not interfering, that structure is assumed in which each ion is surrounded by as many as possible of the other kind. For salts of the general formula AB_2, the CaF_2 structure type is preferred except for large ratios ($R_B:R_A$), as predicted according to the same assumptions. The greater the ratio $R_{large}:R_{small}$, the greater is the tendency to form hydrates and ammoniates and the greater the stability of those formed, as predicted from the assumptions that hydrate and ammoniate formation parallels the magnitude of the stray field in the simple salt and that such stray field increases with the ionic radii ratio. The various types of temperature-composition diagram correspond with the ionic radii ratios. T. H. P.

1188. *Rhythmic Precipitation* (*Liesegang*). **R. Fricke** and **O. Suwelack.** (Zeits. phys. Chem. 124. pp. 359–392, Dec. 30, 1926.)—The experiments are made by allowing ammonia to diffuse into agar-jelly impregnated with magnesium-ammonium chloride and examining slices of the jelly, cut with a microtome, in which all the ions are determined. The phenomena accord with normal diffusion and precipitation. H. B.

1189. ***Physical Phenomena at Interfaces, with Special Reference to Molecular Orientation.*** (Faraday Soc., Trans. 22. pp. 434–500, Dec., 1926.)—A general discussion on the subject comprising the following nine papers, together with expressions of views by various contributors: "General Discussion on Physical Phenomena with Special Reference to Molecular Orientation (Introductory Survey)," by **E. K. Rideal.** In the case of insoluble films on a liquid surface the evidence for a two-dimensional unimolecular phase capable of existing in the solid, two liquid, the condensed and expanded, vaporous, gaseous and allotropic solid states has been confirmed and extended. The conditions of equilibrium of these films with crystals or lenses of materials from which they are formed conform to the generalisations embraced by the phase rule. Interfacial electrification, the evidence supporting the view that adsorbed molecules are orientated, and allied subjects are also considered.—"Electrification at Interfaces," by **H. Freundlich.** Electrification at interfaces is governed by the distinction between the thermodynamic potential and the electrokinetic potential, this distinction necessitating two assumptions: (1) The electric double layer at the interface must be, not a strict double layer as suggested by Helmholtz, but a so-called "diffuse" double layer in which the ions of the layer in the liquid phase are not all strictly bound to the one surface. (2) A thin film of the liquid adheres firmly to the solid wall of the other phase. The thermodynamic potential is the true potential between the two phases, whereas the electrokinetic potential is the potential between the movable liquid phase and the thin film of liquid adhering to the solid wall. Experimental data referring to the behaviour of these two potentials are discussed, and it is shown that the distinction between the two is a valuable guide in the study of the phenomena correlated with the electrification of surfaces.—"Electrification at Interfaces," by **R. K. Schofield.** By restraining free kinetic movement, the interfacial forces which cause adsorption and molecular orientation set up a distribution of volume electrification, thereby giving the surface an electric moment and hence a transverse difference of potential. The study of the electric moment of an interface by observation of the relation of its charge to the accompanying charge in surface tension is best carried out by means of Gibbs' thermodynamic adsorption equation, which reveals great complexity in the ionic and molecular arrangements making up the electric moment of an interface and shows the complete inadequacy of the simple theory of an interfacial "condenser." Thus, it shows that the disturbance set up by a charged mercury surface in a neighbouring solution extends to a considerable depth (tenths of Å.), and supports the view that throughout part at least of the region carrying volume electrification the ions are separated by a medium of which the dielectric constant does not differ greatly from that of water in bulk. Molecules orientated at an interface and having electric moments either inherent or induced, though they contribute to the total p.d., cannot cause electrokinetic phenomena, for the appearance of which the possibility of a relative movement of two layers carrying volume electrification of opposite sign would appear to be essential.—"Adsorption on Solids," by **W. E. Garner.** Reference is made to the part played by the fine structure of the solid surface in adsorption processes and in the kinetics of heterogeneous reactions, to surface energy and surface forces, to adsorption isotherms, monomolecular films, molecular orientation, etc.—"Molecular Orientation in Solids," by **G. Shearer.** The bearing of X-ray measurements on this subject is considered. Study of the structure of long-chain carbon compounds shows that there is one set of planes in the crystal whose spacing is very much greater than with the other planes, and that this spacing increases uniformly with the carbon content of the molecule. Moreover, in any one series of carbon compounds the unit cells are of approximately the same cross-section, the area, about 41·4 Å^2., being a measure of the space occupied by the base of two molecules. Some doubt still exists as to the precise arrangement of the molecules lengthwise. The relative strengths of certain of the bonds joining molecule to molecule, the relationship between the type of orientation found in molecular aggregates other than solids and that which is the principal characteristic of the crystal, the probability that the double and single layers found in long-chain crystals have considerable bearing on the formation of oriented films, the inactivity of the groups at the outer ends of the double layer, etc., are also discussed.—" Insoluble Films on Liquid Surfaces," by **N. K. Adam** and **G. Jessop.** See Abstracts 1199 and 1200 (1926).—" Spreading of Proteins," by **E. Gorter** and **F. Grendel.** Proteins are able to spread on water in a monomolecular layer. Hæmoglobin, casein, serum proteins and muscle proteins spread in a film only 6·75 Å. in thickness if the suitable hydrogen ion concentration (mostly pH = 1) and temperature are chosen. Other proteins (gelatin, gliadin) do not spread well, their behaviour being comparable to that of the short-chained fats. When spread on distilled water, proteins do not show this minimal value for the thickness of the layer; in this case time has a considerable influence, whereas it has none when strongly acid water is used. At the isoelectric point and at pH = 1 or 2, the very thin monomolecular film is obtained, but on either side of this point the thickness increases, often threefold. Rise of temperature enhances the spreading only of proteins of the hæmoglobin and casein type, but the spreading of proteins of the gelatin-gliadin group is better at lower temperatures. The spreading of proteins in thin films is due to the attraction of the CO.NH groups of the molecule to the water. Certain points of technique are discussed.—" Some Physical Properties of Composite Surfaces," by **W. Ramsden.** Such questions as massed adsorpta, the viscosity or rigidity of adsorption surfaces, the re- or in-solubility of massed adsorpta, surface rigidification, etc., are briefly discussed.—" Arrangement of Molecules on the Surface of Pure Liquids," by **S. Sugden.** The assumption of a particular orientation of the molecules of thin surface films furnishes the simplest and most complete interpretation of the behaviour of such films under compression and of the regular and consistent values found for the dimensions of molecules. In the present state of knowledge it is impossible to prove that orientation cannot occur at the surface of a pure liquid, but it has been shown that such an ordered arrangement of the surface molecules, if existing, does not affect the total surface energy as would be expected, and that the kinetic theory sets definite limits to the existence of any high degree of orientation. The author is of the opinion that the surface properties of pure liquids are best accounted for by the theory of a random distribution of the surface molecules. T. H. P.

1190. *Allotropy.* **A. Smits.** (Nature, 118. pp. 916–920, Dec. 25, 1926.)—The results obtained by Baker [see Abstract 1784 (1922)] are discussed in relation to the author's theory of allotropy (*The Theory of Allotropy,* 1922), which assumes that every state of aggregation, even of the most simple substance, in reality is complex, being built up of molecules of different kinds. The difference may be one of structure or one of size. With benzene the molecules differ probably in size, and it may be assumed that some are simple and others associated $(C_6H_6)_n$. The fact that benzene, although a mixture of different molecules with different physical properties, behaves as a simple substance, is due to the great velocity with which these different molecules undergo mutual transformation, $nC_6H_6 \rightleftarrows (C_6H_6)_n$. Thus, a so-called simple substance is actually a mixture with an inner equilibrium. When benzene, for instance, is intensively dried, the mutual transformations of the molecules of different kinds no longer take place, so that the substance becomes an ordinary mixture. The components of the latter doubtless vary in volatility, so that, when the benzene is heated, the more volatile part will escape first and, by the time the boiling point is reached, the liquid will be richer in the less volatile portions and will thus begin to boil at a temperature higher than the boiling point of moist benzene. The process of intensive drying also effects some change in the relative amounts of the different kinds of molecule originally present, that is, effects a change of the inner equilibrium. The observation that the melting point and the transition point of a substance depend on its previous history can also be predicted from the author's theory. The velocity with which the inner equilibrium between the different kinds of molecules is established in the different states of aggregation seems to be a characteristic property of substances, so that it becomes possible to speak of " rapid " and " slow " substances.

T. H. P.

1191. *Experiments on the Production of Large Copper Crystals.* **H. C. H. Carpenter** and **S. Tamura.** (Roy. Soc., Proc. 113. pp. 28–43, Nov. 1, 1926.)—This investigation continues previous work on the preparation of " single-crystal " test-pieces of aluminium [see Abstract 1029 (1922)]. Crystals exceeding 4 in. in length have been grown in polycrystalline copper strip of section 0·5 in. × 0·125 in. by the method of critical strain followed by appropriate heat treatment. These crystals, however, contain numerous twins which may be oriented in as many as three directions, and it has not been found possible to produce large copper crystals by this method without at the same time producing twins. The complete removal of strain in recrystallised copper strip is only achieved by prolonged heating. On account of the presence of twins, the large crystals thus prepared only possess about one-third of the ductility of polycrystalline copper. Their tenacity, however, is almost the same, but their ductility is still more inferior to that of single-crystal copper prepared direct from the liquid which is free from twins. The paper contains full experimental details with diagrams and photographs. H. H. Ho.

1192. *The Metallography of Solid Mercury and Amalgams.* **W. Rosenhain** and **A. J. Murphy.** (Roy. Soc., Proc. 113. pp. 1–6, Nov. 1, 1926.)—Apparatus and methods are described whereby the microstructure of mercury and dilute amalgams in the solid state has been revealed and examined. CO_2 snow is used to obtain the low temperature required, and specimens having a smooth surface have been obtained by solidification against a glass surface or by polishing. The cast surfaces have been etched electrolytically in hydrochloric acid, and, by the use of a device to prevent the deposition of frost on the surface of the specimen or the objective lens, have been examined microscopically. Photomicrographs of the structures observed are included. A. A. D.

1193. *Structure Analogies of Alloys.* **A. Westgren** and **G. Phragmén.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19. No. 12. pp. 1–5, 1926. In English.)—X-ray analyses show that certain types of atomic grouping recur in different metallic systems [see Abstract 2178 (1925)]. It is now shown that a Cu-Sn phase containing about 20 atomic per cent. of Sn has a structure closely related to that of the γ phases of the Cu-Zn and Cu-Al alloys. These latter are both cubic with 52 atoms in the elementary cube. In the corresponding Cu-Sn phase there are 416 atoms in the elementary cube. Similar analogies are shown for other compositions, and diagrams are given for the three series mentioned above, showing for each of them the ranges of composition in which they have similar structures. It is suggested that the atomic grouping, and thus the chemical nature of compound metallic phases, is to a considerable degree regulated by their concentrations of valency electrons. With rising valency of the metal added to copper or silver the phases of analogous structure are displaced towards the copper or silver side of the diagram about as much as is required on this hypothesis. A. A. D.

1194. *Acid-Resisting Metals and Alloys.* **W. Guertler.** (Zeits. f. Metallkunde, 18. pp. 365–376, Dec., 1926.)—This paper and those dealt with in the two following abstracts were read at a conference held in Hamburg in June, 1926. The following points are considered: Chemical corrosion and metallic affinity; direct thermochemical and electrochemical methods of arranging the metals in series; graphical representation of the heat of combination of the elements with oxygen, sulphur, etc.; the electrolytic relations between metals; the behaviour of heterogeneous alloys; the behaviour of metalloids; homopolar and heteropolar properties; the significance of solid solutions; effect of the space lattice; application of experimental results to alloys used in practice. A. A. D.

1195. *Chemically-Resistant Alloys and their Properties.* **E. H. Schulz** and **W. Jenge.** (Zeits. f. Metallkunde, 18. pp. 377–386, Dec., 1926.)—Some of the relevant chemical and physical properties of the following materials are dealt with: Silicon-iron and other cast alloys; malleable chromium and nickel-chromium steels; alloys of nickel and cobalt with chromium. The mechanical properties of certain of the alloys are given, some of the data relating to tests carried out at temperatures up to 700° C. A. A. D.

1196. *Acid-Resisting Alloys with Nickel as a Basis.* **W. Rohn.** (Zeits. f. Metallkunde, 18. pp. 387–396, Dec., 1926.)—The loss of weight in gm./sq. cm. has been determined for the following metals in five different acids, Fe, Ni, Co, Cr, Mo, and W. The acids were of 10 % strength and the tests were carried out at different temperatures and with varying time of immersion of the metals. Two series of alloys are considered, one with iron as the basis and the other with nickel, the most systematic investigation relating to this latter group. The results are given in a series of tables, and numerous photographs show the corrosion effects on a selection of the rods tested. A. A. D.

1197. *Corrosion Products and Mechanical Properties of Certain Light Aluminium Alloys as Affected by Atmospheric Exposure.* **E. Wilson.** (Phys. Soc., Proc. 39. pp. 15–23; Disc., 23–25, Dec., 1926.)—The paper gives an account of experiments which have been made upon the electrical conductivities, the corrosion products and tensile properties of high purity aluminium and certain light aluminium alloys, which have been exposed to the London atmosphere for a period of twenty-four years. The elements concerned are copper, nickel, manganese and zinc in varying amounts up to a few per cent. The variation of the electrical conductivity, the growth of the corrosion product and its composition have been studied, and the tensile properties before and after exposure have been compared. Finally, there is a note on the corrosion products of high-conductivity copper. AUTHOR.

1198. *Effect of Working on the Physical Properties of Tungsten.* **J. W. Avery** and **C. J. Smithells.** (Phys. Soc., Proc. 39. pp. 85–96; Disc., 96, Dec., 1926.)—Changes in the density and resistivity of tungsten during swaging and drawing have been investigated. The densities of pure and thoriated tungsten (0·63 % thoria) from the sintered bar down to wires 0·02 mm. in diameter are given. The experimental advantages of the use of benzene as the displaced liquid are mentioned. Measurements of the densities of specimens cleaned in successive stages by etching reveal the presence of low-density surface layers. Variations of heat treatment likely to occur in practice are shown to have no appreciable effect upon the density of worked tungsten. The density rises rapidly during swaging to a maximum value within 0·5 % of the density of the perfect tungsten crystal. Further working produces a steady fall in density, which becomes more marked in the finest sizes. Measurements have been made of the resistivity of the same specimens. The resistivity falls rapidly in the early stages of working and reaches a minimum when the density is a maximum. It then increases at a uniform rate, which is approximately an exponential function of the diameter. AUTHORS.

1199. *Diffusion of Zinc in the α Series of Solid Solution in Copper.* **J. S. Dunn.** (Chem. Soc., J. pp. 2973–2979, Dec., 1926.)—The loss of zinc from a heated brass surface was studied by heating a helical coil of wire in a silica tube connected to a Toepler pump which maintained a vacuum during the heating. At the end of the experiment the tube was withdrawn from the furnace, allowed to cool, and the loss of zinc determined by weighing the wire helix. It was shown that measurements of the diffusion coefficient of zinc in the α ranges of solid solution in copper can be made by observing the rate of loss of zinc. The diffusion coefficient was shown to vary exponentially with the zinc content and temperature. The temperature coefficient of diffusion was found to agree with that calculated from the Rideal-Dushman unimolecular reaction equation, and the general use of the experimental method for the investigation of diffusion in solid solution was discussed. F. J. B.

1200. *Cementation of Iron by Silicon Chloride.* **A. Sanfourche.** (Comptes Rendus, 183. pp. 791–793, Nov. 8, 1926.)—Chloride of silicon is reduced at a high temperature by iron, forming chloride of iron and liberating silicon, which combines with the iron. This reaction was used to study the reaction of bars of compact iron with silicon. Silicon chloride was heated to 40° C. and the vapour led over bars of iron, heated in a silica tube by a current of nitrogen. At a temperature of 800° C. reaction took place and the bars became covered with a superficial layer of a silicon-iron alloy. When the nitrogen was replaced by hydrogen, the reaction became more vigorous, the iron acting as a catalyst and assisting the decomposition of the silicon chloride by hydrogen. The reaction proceeded until the iron contained about 14 % of silicon, which corresponded to the compound Fe_3Si. This behaviour is in keeping with carbon and titanium, which form the compounds Fe_3C and Fe_3Ti. F. J. B.

1201. *Cementation of Mild Steel by Cyanogen and Cyanamide.* **E. Pérot.** (Comptes Rendus, 183. pp. 1108–1110, Dec. 6, 1926.)—Test pieces of mild steel, containing 0·15 % carbon, were heated in a silica tube furnace in an atmosphere of cyanogen gas, and the steel was examined microscopically. At a temperature of 800° C. the cementation proceeded proportionally to the time of heating. At 900° C. the cementation proceeded rapidly at first, and then more slowly. The specimens were covered with a coating of carbon after the treatment. Reduction of pressure below 760 mm. had practically no effect on the cementation. Dilution of the cyanogen with air diminished the external coating of carbon. Cementation was also effected by heating the steel in contact with tri-calcium cyanamide. F. J. B.

1202. *Cementation of Aluminium by Copper.* **J. Cournot** and **E. Pérot.** (Comptes Rendus, 183. pp. 1289–1291, Dec. 20, 1926.)—Trying various methods, the authors obtain the best results by heating the aluminium cylinders to be treated in a neutral atmosphere in an electric furnace after having deposited electrolytic copper on the specimen. The cementation sets in above 544° C., the temperature of the solid solution of the eutectic Al_2Cu. The electrolysis was effected by currents of 0·75 A for 45 minutes; the heating was always for 30 minutes. As the temperature rose up to 660° C. the penetration of the alloy into the core increased continuously to 1·59 mm., but the Brinell hardness attained its maximum near 615° C. H. B.

1203. *Isohydric Solutions and the Velocity of Chemical Change.* **H. M. Dawson** and **C. R. Hoskins.** (Leeds Philosoph. and Lit. Soc., Proc. 1. pp. 108–112, Oct., 1926.)—The hydrogen-ion theory of acid catalysis is tested with the iodine-acetone reaction by adding solutions prepared from a stock solution of normal acetic acid and sodium acetate, which is diluted in successive stages until the concentration of acid and salt is reduced to 0·005 N. The solutions are approximately isohydric, though with increasing concentration of acid and salt the velocity of the reaction is largely increased, the observed velocity for the 1·0 N solution being about 160 times as great as that for the 0·005 N solution. The results indicate that apart from the hydrogen and hydroxyl ions, a large catalytic action is also produced by the acid anion and the undissociated acid. Activity coefficients of the different components are calculated and from the equilibrium changes on dilution an approximate formula is derived in which $v10^6 = 6 \cdot 0c + 0 \cdot 014$, where v is the reaction velocity and c the molecular concentration of acid and salt. The experimental results are in close agreement with this equation, from which it follows that the proportion of the total catalytic effect, which is attributable to hydrogen and hydroxyl ions, amounts to about 32 % when $c = 0 \cdot 005$, but only to about 1 % when $c = 0 \cdot 2$. J. N. P.

1204. *Experiments on the Transmutation of Mercury into Gold at High Current Strengths using a High-Pressure Mercury-Arc Lamp.* **F. Bernhardt.** (Phys. Zeits. 27. pp. 713–715, Nov. 15, 1926.)—The paper commences with a detailed description of a mercury-arc lamp considered suitable for transmutation work in which all the favouring factors have been greatly intensified. Experiments are then described with minute chemical details of the precautions taken to ensure the validity of the results. The yield of gold, however, was in every case only of the dimensional order of the impurities present. Proportionality between gold yield and number of ampere-hours could not be established.

H. H. Ho.

1205. *Gold from Mercury.* **E. Duhme** and **A. Lotz.** (Zeits. techn. Physik, 7. 11. pp. 555–556, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—Various means are indicated by which gold may be carried over with mercury during distillation, and distillation apparatus is described for obtaining gold-free mercury. The experimental data show that in no case was any trace of gold detectable as a result of the electrical treatment of mercury. When mercury containing gold, but free from base metals such as iron, nickel, etc., is dissolved in 40–60 % nitric acid at 20–50° C. with stirring of the acid, quantities as small as 10^{-8} gramme of gold are detectable. If the acid used is more concentrated, or if other metals are present, secondary phenomena intervene and render quantitative microscopic estimation of the gold impossible.

T. H. P.

1206. *Transmutation of Lead.* **A. Smits** and **A. Karssen.** (Zeits. Elektrochem. 32. pp. 577–586, Dec., 1926.)—Regarding, on their theory of allotropy, every phase of a so-called elementary substance as complex and a metal as consisting in the simplest case of atoms, ions (of the same or different valency) and electrons in internal equilibrium, the authors consider that a metal should, on rapid anodic dissolution, become more noble, and that more intense electric disturbances should destroy even the inner atomic equilibrium. Experiments are made with lead, so far considered the final product of radioactive decay. Exceptional measures are taken to ensure the highest purity. The lead is fused in a nitrogen atmosphere in an arc lamp of quartz (of the vapour type) provided with electrodes of steel and carbon; the main tube, slightly inclined, can further be heated by gas burners and be turned about its vertical axis or be rocked. After repeated heating for hours (ten) mercury lines appear in the vapour spectrum, as well as some new lines. High current density (100 A) is more effective for this purpose than high potential; the best results were obtained by rocking the thin liquid film so as to interrupt it fifty times per minute. Various checks are used to exclude errors; but the results could not be reproduced when the lamp was slightly modified. With long continued heating the lead attacked the quartz in spots, which were blackened by reduced silicon. In another series of experiments lead electrodes were mounted in steel sleeves so as to face one another in a glass vessel filled with carbon disulphide, and direct current at 160,000 volts was switched on. After a few minutes the cloud of lead particles would lower the potential, but the experiment could be resumed after filtering the liquid. The elaborate analysis showed that the 30 gm. of disintegrated lead contained, after one hour's treatment with 10 milliamperes at 160,000 volts, 0·1 to 0·2 milligramme of mercury, determined as iodide; the fact is described as established. The paper illustrates the apparatus and spectra. H. B.

1207. *Oxidation and Luminescence of Phosphorus Vapours at Low Pressure.* **J. Chariton** and **Z. Walta.** (Zeits. f. Physik, 39. 7–8. pp. 547–556, 1926.)—The experiments are made by admitting oxygen through a capillary tube into a large glass bulb which is provided with a tubular extension at the bottom; phosphorus is placed in this tube, and the whole of the tube heated in an electric furnace. The gas pressures are determined by a McLeod gauge down to 10^{-5} mm. Hg. When a stream of oxygen enters the bulb the reaction velocity does not depend upon the pressure; the reaction velocity could not actually be determined, it is evidently very high. The reaction and the luminescence seem to require a minimum critical oxygen pressure; once started, however, it continues though the oxygen stream may be cut off. The critical pressure rises when more phosphorus is evaporated. When argon is mixed with the oxygen the critical pressure and the light intensity are diminished; an electric discharge sent through the gas has the same effect. It is suggested this phosphorus vapour contains molecules P_4 and P_2; as the temperature rises more P_4 is formed; the reaction is limited to the P_2 and is autocatalytic. The electric discharge would form new reaction centres; electrically-heated platinum wires were quickly destroyed by the phosphorus; hot tungsten wires lowered the critical pressure. H. B.

1208. *Thermal Reactivity of Ozone in Presence of Hydrogen.* **J. W. Belton, R. O. Griffith** and **A. McKeown.** (Chem. Soc., J. pp. 3153–3166, Dec., 1926.)—The earlier experiments [see Abstract 199 (1926)], showing that helium, argon, nitrogen and carbon dioxide exert a definite positive catalytic effect on the rate of thermal decomposition of ozone at 100° C., are now extended to mixtures of ozone, oxygen and hydrogen at 78° C. and 100° C. In such mixtures two reactions occur, namely, the deozonisation process, $2O_3 \rightarrow 3O_2$, and a water-forming reaction $H_2 + O_3 \rightarrow H_2O + O_2$. The values of k_2 and k_1, the respective bimolecular velocity coefficients, both increase markedly with increasing partial pressure of hydrogen, but decrease with increasing partial pressure of oxygen. The ratio $k_2 : k_1$ varies relatively slightly with the composition of the gaseous mixture, lying between 22 and 17 at both temperatures. The value of the temperature coefficient of k_2 in absence of hydrogen is 2·9, and in presence of excess of hydrogen, 2·4. T. H. P.

1209. *Chemical Reactions of Hydrogen Atoms.* **H. S. Taylor.** (Am. Chem. Soc., J. 48. pp. 2840–2848, Nov., 1926.)—Atomic hydrogen is prepared by the method of Wood employing a high-tension discharge through moist hydrogen and by that of Cario and Franck in which the gas in presence of mercury vapour is exposed to the radiation from a mercury arc. An apparatus is adapted in which, in one type, the arc is formed around a quartz tube which forms the reaction system, or as in a second type, around the outer jacket of a water-cooling system for the quartz reaction vessel proper. The reaction of atomic hydrogen with oxygen, carbon monoxide, ethylene and oxygen is described. It is observed that the order of catalytic activity of the metals for the recombination of hydrogen atoms is the order of the hydrogen overvoltage series. The presence of atomic hydrogen at the kathode during electrolysis is indicated by the formation of hydrogen peroxide which occurs on bubbling oxygen over a kathode at which hydrogen is being liberated, while if air or oxygen is completely excluded from the kathode, no hydrogen peroxide is formed. There is an increasing body of evidence that atomic hydrogen is involved in the parallel actions of kathodic reductions and catalytic hydrogenation. The mechanism of the Cario-Franck method of producing atoms is discussed, the evidence indicating that excited mercury functions as a dehydrogenation agent. [See Abstract 589 (1926).] J. N. P.

1210. *Comparison between the Effects of the Electric Spark and Thermal Dissociation.* **P. Jolibois, H. Lefebvre** and **P. Montagne.** (Comptes Rendus, 183. pp. 784–786, Nov. 8, 1926.)—Continuing previous studies [see Abstract 1937 (1926)] on the continued action of condensed sparks on CO_2 at reduced pressures, limiting values for the degree of dissociation into CO and O are plotted against pressure for various condenser capacities. In considering the analogous dissociation by heat, the temperature required to produce a degree of dissociation equal to that produced under similar conditions by sparking is referred to as the "apparent temperature of the spark." This temperature increases with the capacity of the condenser at all pressures. When the capacity is above 0·1 microfarad the apparent temperature is independent of the pressure, having a value of about 3000° C. absolute with a capacity of 10 microfarads. With small capacities the apparent temperature is lower, but always above 2000° C. absolute. Its variations as a function of pressure are complex. A. B. C. L.

1211. *The Mechanism of Chemical Reactions.* **H. S. Taylor.** (Am. Phil. Soc., Proc. 65. 2. pp. 90–98, 1926.)—Brings forward a variety of evidence for the view that a number of reduction processes depend on the intervention of hydrogen atoms, especially reactions conducted in the presence of excited mercury vapour. The evidence includes the production of hydrogen peroxide from mixtures of hydrogen and oxygen; also the observed ratio between the number of molecules reacting and the quanta absorbed, at least twenty molecules of hydrogen disappear per quantum at a frequency corresponding to $\lambda = 2536 \cdot 7$ Å. Further evidence is supplied by experiments which show the sensitisation of the reaction between hydrogen and ethylene by the thermal decomposition of metallic allkyls. H. N. A.

1212. *Initial Stages of the Dehydrogenation and Isomeric Change of Allyl Alcohol.* **F. H. Constable.** (Roy. Soc., Proc. 113. pp. 254–258, Dec. 1, 1926.)—The reaction of allyl alcohol in the presence of a Cu catalyst is studied over the temperature range 245–280° C., the flow rate being made sufficiently large to render the concentration of resultants negligible. A relatively slow dehydrogenation occurs with a temperature coefficient of 1·5, together with a considerably faster isomeric change to propionic aldehyde of temperature coefficient 1·16. The relative rates of the two reactions can be altered by sintering the catalyst. The rate of dehydrogenation is approximately equal to that of the dehydrogenation of ethyl alcohol. The evidence is in favour of the existence of two active areas corresponding to each reaction, and it is considered that true isomeric change occurs in the allyl alcohol molecule, and not rehydrogenation. A. B. C. L.

1213. *Mechanism of Activation at Catalytic Surfaces.* **H. S. Taylor.** (Roy. Soc., Proc. 113. pp. 77–86, Nov. 1, 1926.)—Recent experimental work [see Abstract 1768 (1926)] on the subject is reviewed and discussed, and it is indicated that the activation of diatomic molecules at metal catalyst surfaces consists in the production of adsorbed atoms. The evidence is concerned with both ionisation potentials and heats of adsorption. The data on heats of adsorption are utilised to present a satisfactory explanation of the decomposition of HI and NH_3 at Pt surfaces and the reasons for the acceleration of the velocity observed. A. B. C. L.

1214. *Decomposition Potentials and Metal Overvoltages in Liquid Ammonia and Water.* **A. A. Groening** and **H. P. Cady.** (J. Phys. Chem. 30. pp. 1597–1615, Dec., 1926.)—The "dynamic" decomposition voltage, *i.e.*, the voltage obtained by extrapolating the current-voltage curve to zero current, and the metal overvoltage at zero current density were measured for a series of salts in solution in liquid ammonia and in water by the direct method, avoiding changes in concentration in the vicinity of the electrodes by rotating the electrodes. The dynamic decomposition voltages of nitrates and chlorides are lower in liquid ammonia than in water, the iodides and nitrites being higher. The metal overvoltages are generally higher in liquid ammonia than in water. Traces of water in ammonia or ammonia in water have a considerable effect on the decomposition voltages and overvoltages of copper nitrate. Ammonium salts in dry liquid ammonia have the same dynamic decomposition voltage, *viz.*, 2·1 volts. Temperature has only a very slight effect on the dynamic decomposition voltage in liquid ammonia. B. W. C.

1215. *The Potential of the Fluorine Electrode from Thermal Data.* **W. M. Latimer.** (Am. Chem. Soc., J. 48. pp. 2868–2869, Nov., 1926.)—The recent determinations of v. Wartenberg of the heats of two reactions involving fluorine, together with the values of Latimer and Buffington [see Abstract 738 (1927)] for the ionic entropies, permit the calculations of a new value for the potential of the fluorine electrode, *viz.*, + 2·85 ± 0·04 volts. The concordant values now obtained are almost a volt higher than that estimated by Berthelot and Moissan from the heat of formation of hydrogen fluoride. H. H. Ho.

1216. *Activity Coefficients of Aqueous Hydrochloric Acid at Extreme Dilutions.* **G. Nonhebel.** (Phil. Mag. 2. pp. 1085–1090, Nov., 1926.)—The e.m.f. of the cell $H_2/HCl\,aq/AgCl/Ag$ is measured over a range of concentration extending from 0·00015 M to 0·04 M. Values of E_0' are plotted against $\sqrt{M}$, where $E_0' = E + 2\frac{RT}{F} ln M$, E being the observed e.m.f. and M the molality of the acid. By extrapolation to infinite dilution values are obtained of E_0. The relation between the observed e.m.f. and the activity coefficient γ is given by the relation $E = E_0 - 2\frac{RT}{F} ln M\gamma$, whence $E_0' = E_0 - 0{\cdot}1183 \log \gamma$. Values of E_0 are calculated from the experimental data by the method of least squares, and the most probable value is estimated to be 0·2228 ± 0·0001 volt, which is in fair agreement with the value of 0·2226 volt obtained by Scatchard by the extrapolation of Linhart's data. The results indicate that the activity coefficient-concentration curve up to 0·005 M is given by the equation $-\log \gamma = A\sqrt{M}$, in which the constant A is equal to 0·39, a value somewhat smaller than that demanded by the equation of Debye for the interionic attraction in a strong electrolyte. [See Abstract 1957 (1924).] J. N. P.

1217. *Differential Potentiometric Titration.* **D. A. MacInnes** and **P. T. Jones.** (Am. Chem. Soc., J. 48. pp. 2831–2836, Nov., 1926.)—Instead of plotting the electromotive force against the volume of the reagent, the end of the titration is more readily obtained if the tangent of the curve E/V is plotted against the volume. The method of Cox, which involved the use of two burettes, is modified so that one burette only is required and the concentration cell, necessary for the measurement, is obtained by the use of a specially designed electrode, which holds a portion of the liquid and protects it from the stirring of the remainder. The measured potentials reach a sharp maximum at the end of the titration. F. J. B.

1218. *Activity Coefficients of Sodium and Potassium Bromides in Concentrated Aqueous Solutions.* **H. S. Harned** and **S. M. Douglas.** (Am. Chem. Soc., J. 48. pp. 3095–3101, Dec., 1926.)—The activity coefficients at 25° C. of potassium bromide, sodium bromide, potassium iodide and sodium iodide at high concentrations are determined from the electromotive forces of cells of the type $Ag/AgX/MX_{(m)}/MxHg/MX_{(m_0)}/AgX/Ag$. The values agree closely with those calculated from Hückel's equation. A comparison of the activity coefficients of the alkali halides in aqueous solutions with the effects they produce on the electrolytic dissociation of water, and also with the contraction effects produced by the solution of these electrolytes in water, leads to the conclusion that the specific deformability of the water molecules brought about by the electrical fields of the different ions is an important factor in determining the differences in free energies of the ions in concentrated solutions. [See also Abstract 515 (1927).] J. N. P.

1219. *Concentration of Praseodymium Material and Electrolytic Preparation and Properties of Metallic Praseodymium.* **J. Wierda** and **H. C. Kremers.** (Am. Electrochem. Soc., Trans. 48. pp. 159–169; Disc., 169–170, 1925.)—Praseodymium material with a probable purity of 99·7 % has been obtained by fractional crystallisation of double magnesium nitrates, fractional precipitation with ammonia in presence of ammonium salts, with magnesium oxide, and with oxalic acid, and, finally, fractional crystallisation of the double manganese nitrates and double ammonium nitrates with cerous ammonium nitrate present. The mean magnetic susceptibility of the resulting oxide, containing 0·02 % neodymium and less than 0·01 % lanthanum, was $13{\cdot}28 \times 10^{-6}$. The metallic praseodymium obtained by electrolysis of the anhydrous chloride is silvery white, and corrodes rapidly in the air, but is not pyrophoric. It is attacked slightly by hot water and vigorously by mineral acids and free halogens. It kindles in the form of filings at 290° C., melts at 940° C., and readily alloys with most metals. The metal is highly malleable and ductile, and the Brinell hardness, using the 500-kilogramme weight, is 25. T. H. P.

1220. *Electrochemical Resonance.* **W. A. Plotnikow.** (Zeits. phys. Chem. 124. pp. 236–244, Nov. 28, 1926.)—Instances are enumerated where the dissociating power of a solvent is not characterised by the value of the dielectric constant. This relation between dielectric constant and dissociating power is, further, not in accordance with Coulomb's law of electrostatic attraction. Different phenomena of electrolytic dissociation cannot be explained by the concentrating of radiation energy in solvents of high dielectric constant. Many substances exhibit considerable dissociation in solvents of low dielectric constant, while one and the same substance is a strong electrolyte in one solvent and a non-conductor in another, though these are of similar dielectric constants. Conductivity phenomena are thus to be attributed, not to the individual nature of the dissolved electrolytes, but to a specific relation between solvent and solute, which is termed electrochemical resonance or correspondence. A substance behaves as an electrolyte when the frequency of its ionic oscillations is equal to or is a multiple of the natural frequency of the molecules of the solvent. The phenomenon of electrochemical resonance is discussed from mechanical and electrodynamical considerations and from the standpoint of the quantum theory. If ν is the radiation frequency of the dissociating medium and A the energy change in the ionisation of the electrolyte, the requirement for electrochemical correspondence is that the values A and νh are equal or simple multiples of one another. The most favourable condition for electrolytic dissociation is when $\nu h = A$. Electrochemical resonance is markedly affected by solvation, which modifies considerably the natural frequency of the solvent. Autoionisation such as occurs with molten salts is explained by the equivalence of the energy change of ionisation with the quantum νh of the molecules. A more probable explanation put forward is that substances which exhibit autoionisation consist of two types of molecules, simple and associated, and the system behaves as a solution of one type in the other. J. N. P.

1221. *The Hydrate Problem. Part V. Electrolytic Transference of Water in Normal Solutions.* **H. Remy.** (Zeits. phys. Chem. 124. pp. 394–404, Dec. 30, 1926.)—With electrolytes which show only slight specific electroendosmose through parchment paper membranes in very dilute solutions (such as 0·001 N), the electroendosmose in sufficiently concentrated solutions diminishes almost completely in comparison with the electrolytic transference of water. In the normal solutions previously investigated [Abstract 902 (1926)] the latter condition was fulfilled, so that the values for the transference of water were given immediately by the observed displacements of the liquid. This is, however, not the case with sodium chloride, which shows very high specific electroendosmosis, or with hydroxylamine hydrochloride, in which the liquid displacement with a normal solution has a pronounced negative value. T. H. P.

1222. *Mechanism of Kolbe's Electrosynthesis.* **D. A. Fairweather** and **O. J. Walker.** (Chem. Soc., J. pp. 3111–3121, Dec., 1926.)—The production of ethane at the anode during the electrolysis of a solution of potassium acetate may result from "oxidation" or from the union of two discharged ions. Experiments were made to decide which of the two alternatives represented the reaction. Solutions of potassium acetate potassium propionate, were electrolysed in both aqueous and non-aqueous solvents. The current density was varied and the anode potential was measured, and the gases analysed. The results showed that the "discharged-ion" theory is the only explanation which satisfactorily accounts for the phenomena observed. The arguments in favour of oxidation put forward by Gibson and Robertson have been shown to be fallacious. It was also shown that synthesis can, and does, take place in non-aqueous solutions to which the oxidation theory is not applicable. F. J. B.

1223. *Hydrogen Overvoltage.* **T. Onoda.** (Faculty of Science, J. Tôkyô, 1. pp. 223–247, Oct. 18, 1926. In English.)—Experiments with platinum, gold, copper and nickel electrodes are made after various chemical and physical treatments. The changes show that the hydrogen overvoltage varies greatly according to the history of the surface of the electrode. The discordant values of hydrogen overvoltage which have appeared in the literature on the subject are attributed to the neglect of the history of the electrode. It is found that anodic polarisation causes many electrodes to have the constant minimum value of overvoltage peculiar to each metal, and independent of its previous value. The change of the minimum hydrogen overvoltage with temperature is found to decrease linearly with the rise of temperature. The temperature coefficients are evaluated. J. N. P.

1224. *Single Potentials in Distribution Equilibrium.* **E. Baur** and **E. Ollemann.** (Zeits. Elektrochem. 32. pp. 547–550, Nov., 1926.)—In a previous paper [see Abstract 202 (1926)] it was shown that single potential measurements were possible in distribution equilibria. This necessitated the elimination of the diffusion potential in the non-aqueous phase. In the present paper the earlier work is discussed, a source of error is found which led to false values for the potentials, and the present state of knowledge on the subject is summarised. F. J. B.

1225. *Electrolytically Deposited Metals.* **F. Foerster.** (Zeits. Elektrochem. 32. pp. 525–534, Nov., 1926. Paper read before the Deut. Bunsen Gesell., Stuttgart, May, 1927.)—The microstructure of copper, tin, and cadmium were examined and the effect of the various additions of gelatine and cresol on the structure was observed. The modification of the structure by the presence of other metals and the use of different current densities was determined. The significance for the refining of tin on the large scale was indicated. F. J. B.

1226. *Electrolytic Preparation and Electromotive Behaviour of Complex Cyanides of Monovalent Nickel and Cobalt.* **G. Grube.** (Zeits. Elektrochem. 32. pp. 561–566, Dec., 1926. Paper read before the Deut. Bunsen Gesell., Stuttgart, May, 1926.)—Electrolytic reduction of potassium nickel-(2)-cyanide in alkaline solution resulted in the formation of potassium nickel-(1)-cyanide. Measurements of the oxidation potential of the reduced solution were made at a temperature of 2° C. Potassium cobalt-(3)-cyanide was prepared and reduced to potassium cobalt-(2)-cyanide by potassium amalgam in an apparatus which permitted of the reduction being carried out in an atmosphere of hydrogen. The reduction was followed by titration with potassium permanganate solution. The potential of the oxidation and reduction cells was determined, employing the reduced cobalt-(2) and the cobalt-(3) solutions as the two parts of the combination. The results lead to the conclusion that monovalent cobalt was present in the solution. F. J. B.

1227. *Electrolytic Protection of Aluminium and Light Alloys and their Resistance to Corrosion by Sea-Water.* **J. Cournot** and **J. Bary.** (Comptes Rendus, 183. pp. 789–791, Nov., 1926.)—The protection of aluminium and light alloys against sea-water was attempted by coating aluminium and duralumin with electrolytic deposits of cadmium, cobalt, chromium, after initially plating with copper. Satisfactory adherent deposits were obtained by this method. The alloys were tested by immersion in artificial sea-water, and the appearance of the plates was observed. The corrosion was more pronounced at the surface of the liquid, and duralumin was worse than aluminium with all the deposits tested. F. J. B.

1228. *Electrocapillary Curve near its Maximum.* **O. K. Rice.** (J. Phys. Chem. 30. pp. 1501–1509, Nov., 1926.)—Calculations of the behaviour of the electrocapillary curve, based on the assumption that the charge resided in the surface of the mercury and that a diffuse layer of ions existed in the solution near the mercury, did not agree with experimental results. Two alternatives are suggested: (1) There may be a diffuse layer of positive particles and electrons in the mercury as well as the diffuse layer on the solution; (2) owing to the finite size of the ions it may be that they can only approach within a certain distance of the surface. Calculations of the surface tension were made in both ways arising from these alternatives, and yield very similar results, which agree better with experimental data than calculations based on the single diffuse layer. It is estimated that not more than one atom in fifty can be ionised into a positive ion and a free electron. F. J. B.

1229. *Observation of Cataphoresis in Colourless Sols. I. The Charge on Rubber in Benzene.* **R. H. Humphry** and **R. S. Jane.** (Faraday Soc., Trans. 22. pp. 420–425; Disc., 426–427, Nov., 1926.)—The difficulty of making satisfactory observations of cataphoresis in the study of colloidal systems in which the dispersion media are non-aqueous is overcome by making use of the difference between the refractive indices of the sol and of the dispersion medium by applying the Toepler "Schlieren" method. In a study of a sol of rubber in benzene it is shown that electric charges of each sign are present in an undried sol and that no appreciable charges are present in a sol prepared from thoroughly-dried materials. The addition of small quantities of electrolytes, sufficient to cause a change in viscosity, has no effect on the charges present in the rubber sol. The bearing of these results on metal sols stabilised by rubber in non-aqueous media and on the so-called electro-viscous effect in rubber sols is discussed. A. B. C. L.

1230. *Two Causes of Error in the Electrolytic Estimation of Nickel in the Presence of Iron.* **C. Marie** and **J. Bertheloot.** (Comptes Rendus, 183. pp. 793–795, Nov. 8, 1926.)—The separation of iron and nickel by precipitating the iron by ammonia is very incomplete owing to the ferric hydrate retaining some nickel. In the electrolytic determination of nickel iron is deposited at the kathode along with the nickel. The adsorption of nickel by ferric hydrate was reduced by the addition of magnesium ions, and the tendency of the iron to be deposited with the nickel was prevented by enclosing the kathode in a diaphragm of filter paper. In this way it was possible to combine the two methods and to avoid the errors of both. In the extreme case the first deposit of nickel which was impure was re-dissolved and re-deposited, and the method gave accurate results.

F. J. B.

1231. *Mechanism of the Electrolytic Interrupter.* **G. Colange.** (Comptes Rendus, 183. pp. 1274–1275, Dec. 20, 1926.)—The electrolysis of dilute H_2SO_4 in a U-tube of which the horizontal part approximates from 15 to 20 cm. in length and 5 mm. diameter gives rise to rapid interruptions at voltages from 110 volts to 700 volts, with a very feeble current consumption, owing to the formation of a gas bubble, of which the character and behaviour over various voltage ranges are described. At voltages higher than 700 volts explosion phenomena appear, which are similar to those observed with the Wehnelt interrupter and are easier to observe. Variations in the composition of the gas in the bubble are recorded, free O_2 appearing only with the higher voltages. A. B. C. L.

1232. *Apparatus for the Electrolytic Preparation of Pure Hydrogen.* **A. Müller.** (Phys. Zeits. 27. pp. 778–779, Dec. 1 1926.)—A type of electrolysis vessel designed by Niese [Abstract 1496 (1923)] is investigated in which nickel electrodes are employed in a 30 % sodium hydroxide solution, and an auxiliary nickel kathode is provided so as to remove dissolved oxygen from the electrolyte. By means of alkaline pyrogallol solution the presence of oxygen is detected in the hydrogen even after passing the gas through a heated tube of copper gauze 25 cm. in length.

J. N. P.

1233. *Electrolysis of Dichromic Acid under a Mercury-Vapour Lamp of High Intensity.* **G. S. Forbes** and **P. A. Leighton.** (J. Phys. Chem. 30. pp. 1628–1633, Dec., 1926.)—Comparison is made between the electrochemical yields obtained in the dark and under the influence of the light from a quartz mercury lamp consuming 1500 watts from chromate solutions of 0·006 to 0·05 N concentration in N to 3 N sulphuric acid, platinum electrodes and many different current densities being used. The curves connecting electrochemical yield with current density exhibit maxima and minima which are mostly explicable in terms of the formation of hydrogen and hydrogen peroxide. The average of over fifty experiments shows the efficiency to be ½ % greater at the illuminated than at the non-illuminated electrode. This difference is attributable, partly or wholly, to local heating in the thin diffusion layer above the kathode, but such local heating is not detectable by measurements of the average temperatures. The absence of any increase in photochemical yield in the light is compatible with light-sensitive chromate if the latter is equally reactive electrochemically before and after excitation. If the slightly greater electrochemical efficiency in the light is due partly to excited chromate, any estimate of the quantum yield would involve various assumptions, in particular one concerning the life of the excited individual upon which its chance of reaching the kathode depends. T. H. P.